AMERICAN MACHINIST

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Universal Milling Machine.

We illustrate on this page a universal milling machine, designed especially with reference to the finer kinds of tool makers' and similar work, yet with sufficient rigidity and strength to take a fairly heavy cut when occasion demands it.

The general design conforms to what is now well settled and standard practice, the foot stock being, however, of a design peculiar to this and other machines by the same builders, while the spiral head is made upon new lines entirely, its construction being shown by our reproduction of the working drawings by which it is made.

The table of the machine can be swiveled to any angle, and it has automatic feed with automatic trip in any position.

The feed has four changes, and is tripped automatically, or by hand, under full cut, as easily as when the table is running light. A full range of spirals, right and left-hand, can be cut from one turn in 1 inch to one turn in 100 inches, by both simple and compound gearing. For every-day practice, the range of simple-geared spirals is amply sufficient, and the gears are as readily changed as on an ordinary screw-cutting lathe.

The spindle is of forged crucible steel, hollow its entire length, and the front end threaded, and hole tapered, so that arbors and chucks, fitting spiral head, will interchange with main spindle.

As stated above, the spiral head is new in design, is so arranged that the elevation of its spindle to or near the vertical position raises the work as little as possible above the platen, and the arc through which it can be rotated in a vertical plane is 210°. It can be used on either end of the table. As will be perceived, the motion is imparted to the worm (for spiral milling) through the medium of helical gears, whose end thrust, as well as that of the worm spindle, is taken by steel balls running on hardened steel surfaces. The smaller perspective engraving is an enlarged view of the same head, as made plain, *i. e.*, without the gearing for rotating the spindle by power. This design of head is believed to secure accuracy, and at the same time great rigidity and strength.

The spindle of the spiral head is also hollow, pieces fifteen-sixteenths inch diameter passing clear through it.

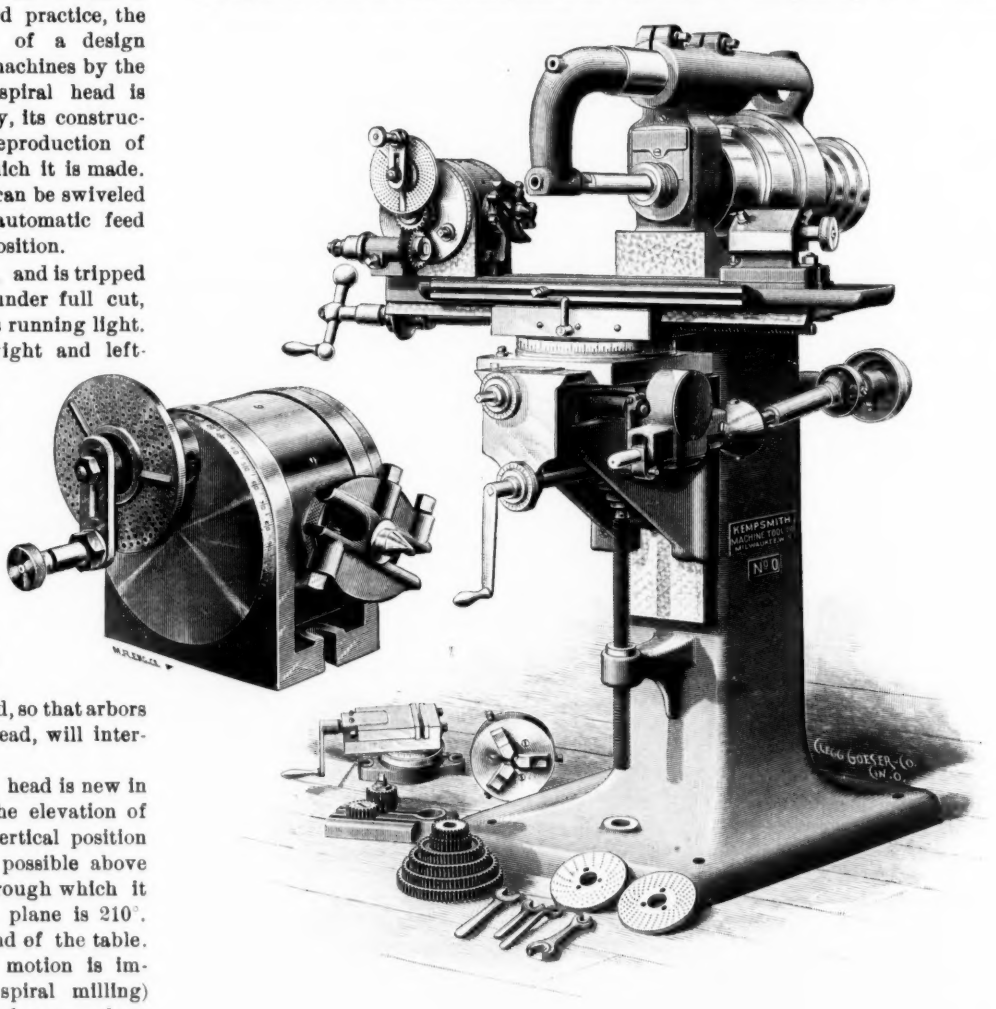
The cone pulley has its smallest step towards the front, which permits the top of the column to slope upward toward the front-spindle bearing, bracing it and securing rigidity. The two spindle bearings are tied together by an arch at the top, which also supports the overhanging arm. A bearing 9 inches long is bored in the arch, slotted at the top, and provided with two clamping screws. The arm can be quickly inserted, clamped fast, and as quickly removed.

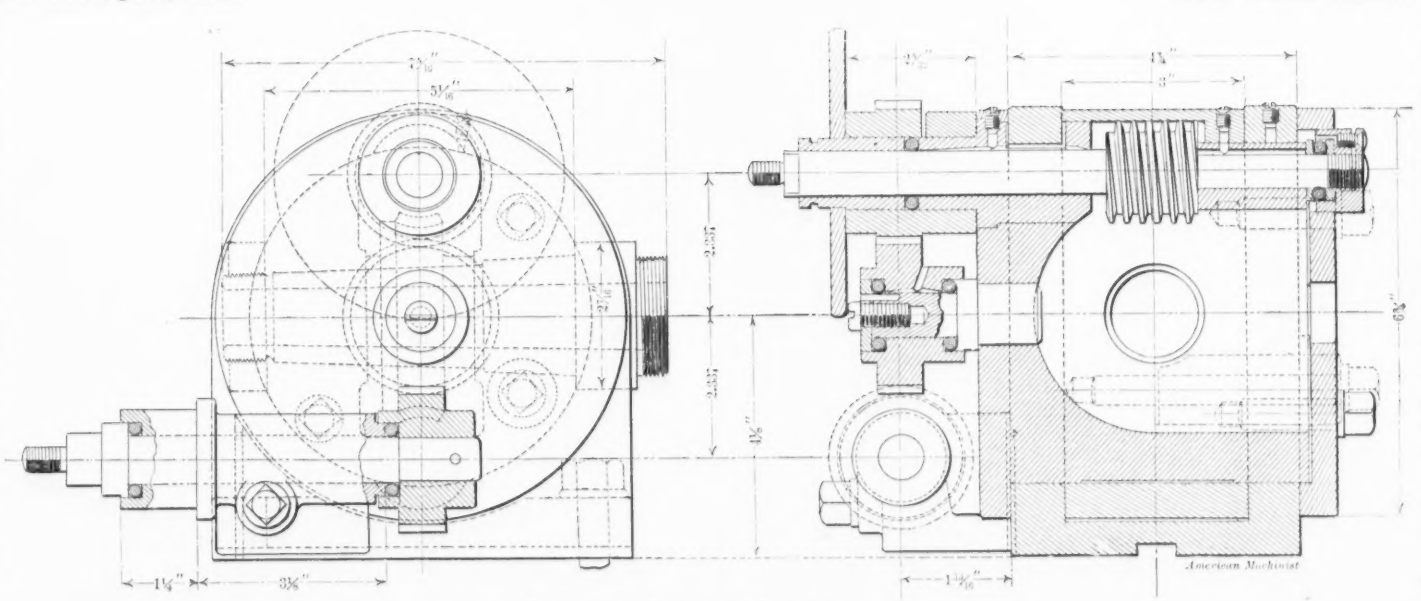
The spindle boxes are of bronze, made in halves. They are cylindrical in form, with a deep rib running around the middle, faced square with the turned surface, and forced into a groove cut into the column and box cap. The outside of the box is finished entirely in the lathe, which makes its reproduction, when worn out, a simple matter.

The elevation to the knee and the cross-motion is indexed to read in thousandths of an inch.

The foot-stock of centers has valuable features in the placing of the center, so that shank or end-milling cutters can be used as close to the inner side of center as to the top. This feature dispenses largely with the use of extremely small cutters, and increases the quantity, and improves the quality of work that can be produced on the machine. Adjustment to take up wear is provided wherever lost motion would affect the accuracy of the machine.

The vertical adjustment of the knee is 14½ inches; in-and-out movement of platen (in line with spindle), 4½ inches; automatic feed, 18 inches; length of platen, including oil-pans, 33 inches; diameter of work taken on centers, 8¼ inches; length between centers, 14 inches; size of front spindle bearing, 2 inches by 3¼ inches; weight of machine, 1,200 pounds. It is made by the Kempsmith Machine Tool Co., Milwaukee, Wis.





UNIVERSAL MILLING MACHINE.

Some Old Practice in Engine Building.

BY W. H. BOOTH.

I have been noticing the discussion of the steam engines at Chicago, a report of which has been appearing in the AMERICAN MACHINIST. There is evidently some thought given to the comparatively easy working of bearings in locomotives under apparently adverse conditions. As the name of Hick-Hargreaves has been mentioned, I would say that I remember going to see one of their large 1,200 or 1,500 horse-power single-crank engines driving a large doubling mill at a place called Eazley, near Bolton, Lancashire. If I recollect rightly, it drove its load with a pair of 3-foot belts, and one narrower one of 12 inches. What I wished to refer to, however, was the very considerable end movement of the crank-shaft—fully half an inch to and fro in the bearings at each revolution.

It seems to me that we need have little hesitation in setting down the general good condition of railroad axles to the longitudinal motion in the bearings.

The Centennial beam engines have been discussed as though they were somewhat abnormal. Excepting the stroke, which was 10 feet, I believe, there was nothing abnormal. A pair of beam engines, with 10 feet stroke, were put to work a few years ago—probably 20—at a mill in Keighley, Yorkshire, and I find in an old note-book that Fairbairns, of Manchester, built what they termed 100 nominal horse-power beam engines, with cylinders 53½ inches diameter, and a stroke of 7 feet 6 inches. They revolved at 18½ revolutions per minute, but were speeded to 20¾.

A pair of nominal 60 horse-power engines at the mills of J. Bright & Bros., of Rochdale, had 40-inch cylinders, 8 feet stroke, and beams 26 feet long, with connecting rods 22 feet long. They originally ran at 18 revolutions per minute, and

I helped to alter them to 26 revolutions, and also to reduce the cylinders to 30 inches to suit a higher pressure.

I am sorry I cannot give some further particulars of large beam engines, but I have seen several very huge affairs, viz., a pair at the India Mill, Darwen, at the India Mills, Stockport, and a very large pair at a mill near Ashton under Lyne (Oldham, Whitaker & Co.'s.) There was a beam pumping engine somewhere at a Lancashire colliery that had a 14-foot stroke.

All these old beam engines were cast from cold blast iron. I have heard it argued that cold blast iron is stronger than hot blast merely in the imagination. Without going into any argument about this, or saying that the greater strength is not due to some other cause than the cold blast, I think one may at least doubt whether the hot blast advocates ever helped to break up an old beam engine. I have, and I hold my opinion as to the old irons.

Horizontal engines were curiosities in my young days, and looked poor affairs by the side of the fine structures they displaced. The horizontal engine, however, came into use with higher pressures, as a means of using what was then the high pressure of 50 pounds before it was exhausted into the old beam engines. The trouble with these latter was not altogether that they were not strong enough to carry the new pressures, but that their foundations were not heavy enough. The cylinders stood on a pier of massive masonry, and the crank shaft was weighted by another wall of heavy blocks, the pillars carrying the entablature under the beam center being also carried on heavy masonry going down 12 to 20 feet. Originally calculated to be amply heavy for boiler pressures of 7 pounds and upwards to 30 pounds, these foundations would lift up at each steam admission, one or other of them, and it became necessary to set the valves late, and wire-draw the steam.

I have mislaid it, or would send a diagram from an engine built by the celebrated Lowmoor Iron Co., to work at a boiler pressure of 7 pounds, about the year 1830. There were stand pipes carried up from the water space of the boilers to a height of about 15 feet above water line. They had open tops, and the water overflowed when the pressure was too great, and gave notice thereby. The engine originally had a stroke of 7 feet, but the crank being condemned, a new one was substituted giving a stroke of 7½ feet, as there was an excess of 1½ inches clearance at each end of the cylinder, which it was deemed well to fill up. There was a complete steam jacket round the cylinder through which the working steam passed on its way to the cylinder. This engine worked at 300 horse-power up to five years ago, for the last ten years of its life, with 50 pounds boiler pressure, and a high-pressure cylinder between the connecting rod and the beam center, this method of compounding being termed McNaughting, from its inventor, as distinguished from the method above described of using horizontal engines to bring the steam down to the range for the beam engine.

A beam engine had a lot of cast-iron about it. The main shaft was cast iron, for there were no steam hammers to make such large shafts. These shafts were cast on end, in a pit, with a large head for dirt, and they always worked better than wrought-iron.

The beam center "gudgeon" was cast, and so were the end gudgeons, and even the pump pins, for the beam worked not only the air pump at its half radius, but the boiler-feed pump. When open stand pipes became unsuitable for the higher pressures beginning to be carried, they were changed for long open-top glass tubes filled with mercury, upon which a few inches of oil was floated. Steam was let into the closed mercury box at the base, and once set right in graduation, there was no trouble with these pressure gauges being inaccurate. Air-pump buckets had no rings; they were simply blocks of cast iron with a wide groove of 3 or 4 inches by 1 inch, and this groove was filled with spruce lagging in narrow pieces driven in tight, and turned to fit the pump, the dry wood swelling as it wore down to a good fit. Sometimes plaited rope was used in place of the spruce.

Gum valves were not known; the foot valve of the air pump was a gun metal flap on two end-bearing pins, and the air-pump bucket had a pair of such heavy doors, whilst the delivery valve was similar, and the air pump top was closed, the rod working through a gland. Though the above represents practice of 1830, and a considerable advance had been made even by the year 1850, the habit of building for eternity brought all this old practice right down to my early days. Prior to 1860, the very profitable state of the cotton trade was bringing forward many new mills with improved engines, but this progress was checked by the war of secession, and economy was the order of the day, and the search for economy brought out compound working to help out the old engines a few years longer. Few beam engines have been built since 1875.

Regarding old engines, one which is probably still working, as it was so valued by its owners, was at a factory at or in the vicinity of Leigh, Lancashire. The beam was a balk of timber of large section, and generally the engine was similar to the Sun and Planet beam engine at South Kensington Museum. Only a few days ago I met the old engineer who removed this museum engine from its old home in a city brewery, and placed it in the museum.

Regarding the trouble so often experienced with hot shaft bearings, this almost invariably comes from careful but brainless workmanship. The erector of the engine takes every care to place the brasses perfectly level, and then he puts in a reaming tool that he calls the crank-shaft neck, and he loads this with 60 or 80 tons in the shape of a wheel, and tries to ream out one end of each bearing. In a few weeks time this smooth-turned reamer does its work, and if the bearings be now tested they will be both found to slope to the shaft center by a small amount, which is simply the measure of the deflection of the shaft under its load. As mentioned by one speaker in the discussion I have referred to, Hick Hargreaves commenced some years ago to allow their crank-shaft bearings to freely swivel, so as to place themselves exactly parallel with the slope of the shaft. This was first done, I believe, for the engines for the Deptford station of one of the London electric lighting companies.

No matter how stiff a shaft may be made, it must deflect somewhat under a heavy central load, and though a mere 100th of an inch in 3 feet may not seem much, it is theoretically sufficient to place all the pressure at one end of a bearing. Where not made to swivel, the bearings ought to be given some inward inclination, but it is difficult to calculate the exact angle of deflection, first, because the shaft varies in diameter towards its middle; secondly, because the load of the wheel is neither concentrated at the one point, nor is it distributed in a manner that can be figured upon; and, thirdly, because the modulus of elasticity of the material of the shaft is not known accurately. In the old days before we planed the under side of a pedestal, it was thought good and proper practice to place a slab of oak or pine between the pedestal and its seat and the result was good. Nowadays our ideas have gone ahead of our abilities to figure up to them, and we plane the base, and its seating, of the pedestal, but cannot line up to our practice. Considering how small a deflection will make so great a mischief, are we not justified in placing a layer of felt under the pedestal, so gaining a distribution of pressure over the whole length of bearing? These remarks, of course, apply more particularly to such engines as have the crank-shaft pedestals separate from the bed castings. Now, all such separate pedestals are customarily made thus in cross section (Fig. 2) at their bases, the parts *a* and *b* being planed. This compels the pedestal to take an even keel on its bearing plate on the bed, and it seems wrong—it is accuracy out of place. I would reverse matters and plane the part *c*, Fig. 3, and I would plane it, or rather mill it ever so little, rounding so that it could accommodate itself exactly to the shaft. Then, with an allowance of 130 pounds per square inch of bearing area (bearing area being length × diameter), there would be very little trouble with hot bearings, but without such precautions, 50 pounds pressure nominally will cause heating. We may sometimes see sheet lead employed to distribute pressure in cases that cannot be accurately arranged otherwise. The mistake with lead is that it is used in continuous sheet, and, perhaps, over too great an area, and its substance is so confined that it cannot flow, and might as well be hard steel. A better plan would

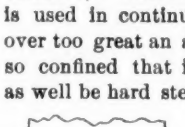


Fig. 2.

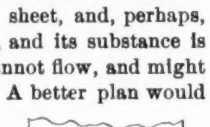


Fig. 3.

be to use lead wire sieve cloth, if it could be got, and failing that, perforated lead, the perforations allowing movement or flow of the surrounding material.

A designer in his office may scheme out matters to his own satisfaction, and in a concern manufacturing articles in quantity his arrangements can be carried out, but we are not all of us connected with such concerns. Many of us are so placed as never to see at work the machinery we have planned, and it is devising machinery that is to be erected at a distance upon masonry and timber foundations that departures must be made from ordinary rules in order to defeat as far as possible the *diablerie* of some stupid fellow one may never even see. The kind of man I have in my mind is he who, though every provision be made for the prevention of the formation of shoulders on, let us say, a round bar sliding to and fro in a bush, by arranging that the bar shall be turned down at each end of its bearing so as to enter the bush a half-inch at each end of its travel, yet contrives to put things together so that this does not take place, and a shoulder forms at one end, in course of time to be a source of trouble if a bearing be lined up so as to alter the position of parts even a trifle. You cannot argue with that stamp of man; he is hopeless. You cannot give him new notions; he is too tied to what he learned years ago. You may disclaim the originality of the ideas you are trying to impart, and credit them honestly to Porter or some other fellow you have looked upon long as a better man than yourself, but it is of no use; he will not hear of anything new, and thus it is we go on perpetuating old patterns in millwrighting that are quite wrong to-day, simply because we have discarded the means which made these patterns good and useful. We have discarded the elastic bedding strips because we have now got planing machines, and we think the old engineers used the strips because they had no planers. But they did not, and our better tools have been the cause of more hot boxes than they have removed. I know a concern which had a sudden outburst of enthusiasm in respect of fine workmanship, and they had a lot of Whitworth gauges, and set out to do a better class of work. The result was that the first machine constructed on the new basis pretty well tore itself to pieces, the bearings seizing all over. Those people confounded good work with fine fits. They were perfectly correct in making things to gauge, but wrong in their gauges; they failed because they fitted two articles made on shop tools to gauges made by the finest methods, forgetting they were making machinery not gauges. What they wanted to do was to work between definite limits fixed by maximum and minimum gauges, but they did not know this, and so went back to the old method—good, but expensive.

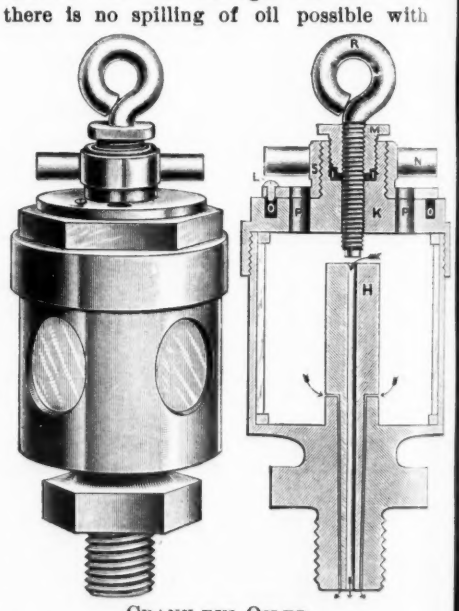
Coming back a moment to the old steam engines, one remembers how steadily they turned despite their slow speed and comparatively light fly-wheels. This doubtless was largely due to the heavy masses of iron to be put in motion by the initial steam, and it used to be remarked that toothed gears would work well when driven by a beam engine that failed when a horizontal engine was employed.

It was simply that no severe shock could travel past the heavy beam and connecting rod.

An Improved Crank-pin Oiler.

We illustrate by the accompanying engravings the latest form of the Safety crank-pin oil cup, a cup which in its original form has been on the market about two years, and has been very successful in overcoming the difficulties commonly experienced with such oilers, though still leaving room for improvement, especially in the direction of simplicity, as the present illustration shows.

H is the plunger which rises and falls with the motion of the engine, forcing part of the desired amount of oil to the crank pin, while at the same time the oil is flashed on top of the plunger and passes down through its hollow center, thus giving two distinct and separate feeds, so that in using this cup there are two chances against its feed becoming clogged. *K* is the cover of the cup, containing two passage ways *P*, *P*. One of these is to allow the oil to enter the cup, and the other is the vent hole by which the air in the cup passes out. On top of the cover is an escutcheon *S*, operated by means of a handle *N* passing through it. When the cup is in operation, this handle is turned hard to the right, bringing the holes in the escutcheon out of line with the holes in the cover of the cup, and the escutcheon being threaded and turning on a corresponding thread on the cup cover, allows of an absolutely tight seat being made between the escutcheon and the cover, so that it is impossible for the oil to spill out while the cup is working. To fill the cup the handle *N* is turned to the left until the holes in the escutcheon and the cover are in line, when the oil can be quickly poured in from a spring bottom can, and as the air is allowed free vent through the vent hole there is no spilling of oil possible with



CRANK PIN OILER.

ordinary care. The screw *L* passing through the escutcheon allows it to turn to the left just a sufficient distance to bring the holes in line. The feed is regulated by the regulating screw *R* which admits of a regulation as fine as $\frac{1}{1000}$ of an inch or less. This regulating screw passes through the stuffing nut *M*, and through the packing *I* in the same manner that the stem of a globe valve passes through its stuffing nut, and the tension on the regulating screw is altered by turning this stuffing nut *M* same as the packing is tightened or loosened on a globe valve.

The plunger *H* having a square shoulder against the bottom of the cup, the oil stops feeding as soon as the engine stops running, and there is therefore no waste. Owing to its fine regulation, it can be set to feed just the desired amount of oil, and with the

proper size cup, it can be so regulated as to run for a half day or a full day as desired, so that the engine need never be stopped to refill the cup, and the only attention required from the engineer is to fill it at the proper times, as it does its work automatically.

The manufacturers are the Penberthy Injector Company, Detroit, Mich.

A New Tap Holder.

We present with this engravings of a new tap holder which is designed to be used in the drill press, lathe or screw machine, and to drive a tap true and steadily until the bottom of the hole is reached or some abnormal resistance encountered, when a friction disk slips and allows the tap to stop while the spindle of the machine runs on.

As will be seen from the engraving the holder consists of a peculiar form of chuck having a taper shank (though, of course, the shank may be of any required form to suit the machine it is to be used in); within the enlarged portion of this chuck is a fiber friction disk (shown in dark cross section lines), this disk having two beveled surfaces the pressure upon which is adjustable by simply turning the outer threaded ring, which is done by a spanner wrench. This ring forces against the friction disk another ring which is driven by three pins, connecting it with the body of the chuck and thus preventing any accidental tightening or loosening of the threaded adjusting ring.

The shank of the tap holding chuck passes through this ring as shown, and is held by two small spring plungers which engage with a groove formed in this shank —one of these plungers only is shown in the engraving.

Collets for driving taper-shank drills can also be used, and can be inserted or removed without stopping the machine.

The fiber friction disk does not drive directly upon the squared portion of the shank, but fits over a squared upward extension of the steel sleeve which itself has a squared hole through it.

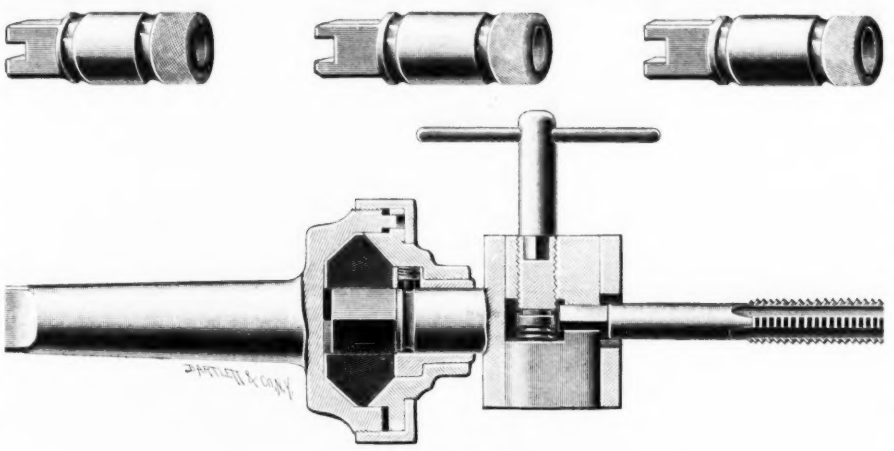
One of these tools which we have examined shows that they are very well made, and in use they have proven very efficient and satisfactory.

They are made in two sizes, one for taps from ¼ inch to ¾ inch, inclusive, the other for taps from ⅜ inch to 1¼ inches, inclusive, by the Pacific Tucking and Mfg. Co., 471–473 Eighteenth street, Brooklyn, N. Y.

Compound Marine Engine.

We illustrate herewith a compound marine engine, built by the Morris Machine Works, Baldwinsville, N. Y. The engraving is of a 5″x10″x6″ engine. The cylinders are cast separately and bolted together with a receiver between them. The high-pressure cylinder has a balanced valve of the same type as that used in the Straight Line engine, and which we have published drawings of. The valve on the low-pressure cylinder is a common "D" valve. The cranks are arranged at an angle of 45 degrees. All working parts, such as piston rod, crosshead, connecting rod, crank shaft and link motion, are made of steel. The cylinders are supported by cast-iron columns behind and polished steel rods in front, giving full view of all the working parts. Oil reservoirs are fitted on the back side of the engine, and by pipes leading from these reservoirs, the crosshead guide, crank-pin, and crosshead pin are automatically oiled. The engine is highly finished in every way. One of them during a recent trial ran continuously at 450 revolutions per minute, showing no tendency to heat.

Mr. Harris Tabor, in a communication which recently appeared in the AMERICAN MACHINIST, makes the following statement: "It is well known that steam cannot be expanded in locomotive cylinders to the extent that is called for in stationary engines, for the exhaust would not be sufficient to give the required draught." This may be one reason why locomotives are not equipped with three and four sets of cylinders, a condenser, air pump, etc., but if so, it is one of such infinitesimal importance that no one has ever before given it recognition, much less stamped it as a well-known fact. If Mr. Tabor had seen his statement in cold type before the paper was issued he would probably have run his pencil through it.—*Railway Review.*

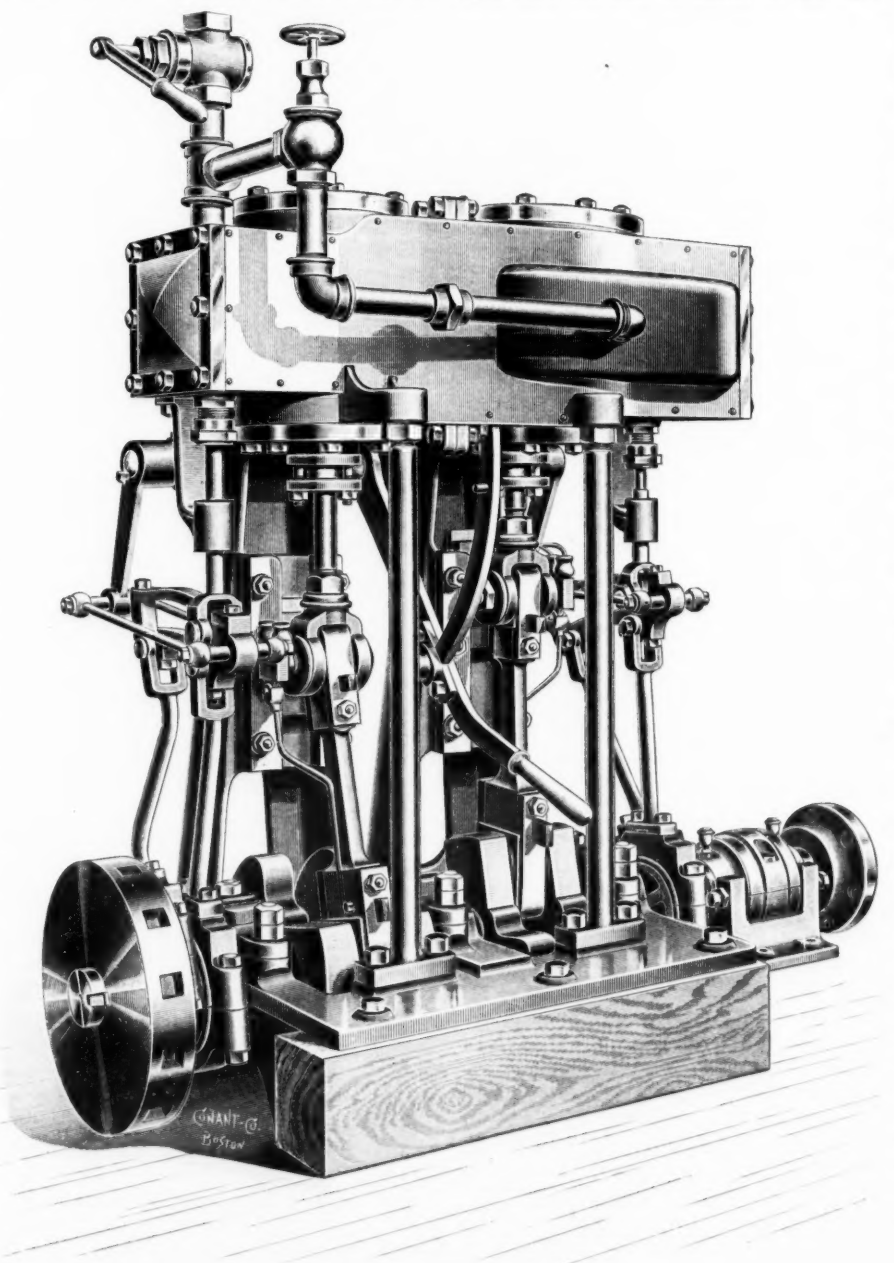


NEW TAP HOLDER.

About Siphons—V.

BY LEICESTER ALLEN.

In my last article (issue of December 28, 1893), I promised in a concluding article to explain a simple device for removing unabsorbed gas from water to be siphoned. By unabsorbed gas is meant gas floating in water in the form of large or small bubbles—a condition entirely different from that of gas held in solution, as will be seen presently. Gas freely floating in the form of bubbles rises to the upper surface of a liquid and there escapes. The larger the bubbles the more rapidly they rise, the outer surfaces of the bubbles, supposing them to be spherical in form, being to their volumes respectively as the squares of their diameters are to the cubes of their diameters. Hence their buoyancy increases as the cubes of their diameters, while the resistance to their rising (a purely surface action) varies as the squares of their diameters. This law holds good for all homogeneous liquids, like water, which latter is all that we need to consider for the present purpose. If, therefore, water, containing large numbers of gas bubbles, be allowed to flow into a deep open vessel over its upper edge, and water be constantly drawn from the bottom of the vessel through a pipe or siphon, all the gas freely floating will rise to the top of the liquid in the vessel and escape into the atmosphere, provided the vessel be large enough to give time for the escape. If the descent of the liquid in the vessel be more rapid than the rate of ascent of the bubbles in still water, some of the bubbles will be carried down and will enter the pipe. Such a reservoir to be effective must be large enough to reduce the velocity of descent to less than the rate at which the gas bubbles rise.



COMPOUND MARINE ENGINE.

When water is to be siphoned from sources where gas is constantly produced through the decomposition of organic matter, or where water is surcharged with gas produced by the chemical reactions of mineral substances, such a vessel placed at the supply end will be found to keep siphons going much longer than they will work without the use of such a device, especially if the flow through the siphon be controlled at the discharge end by a cock, so that it does not work at its full capacity. When working at full capacity, a siphon having a small internal diameter will not fail from the presence of air or gas as soon as one of large diameter. This results partly from the law above set forth governing the separation of bubbles from liquids, and partly from the fact that bubbles of gas adhere with some force to solids. One can often observe such bubbles sticking to the sides of glass vessels containing water or to stakes stuck in the bottoms of springs or pools. In small pipes such bubbles will mass together, and extending across the whole diameter of the pipe will be swept on and finally discharged, precisely as loosely fitting corks would be discharged. In fact, this action may be well illustrated by the action of loosely fitting balls of cork. The latter, ½ inch diameter, might be inserted one after another in the supply end of a siphon $\frac{5}{16}$ inch diameter, and they would be carried on and successively discharged at the other end. But suppose balls of cork of this diameter to be continuously placed in the supply end of a siphon one foot in diameter, the velocity of flow through which should be less than the rate with which the balls would rise through still water by virtue of their own buoyancy. The corks will, under such conditions, no longer be discharged, but will rise to the highest point of the bend and there accumulate. Now, a bubble of gas is a ball much lighter than cork, and it has, moreover, the power of coalescing with other balls of its kind, and if enough of these enter a siphon whose bore is considerably larger than the diameter of the bubbles the latter will often unite in a mass in the bend of the tube, and thus separate the liquid into two integral columns. If the flow through the tube be not sufficiently rapid to sweep on the accumulated air and discharge it the separated columns will continue to separate more and more until finally the flow will stop. The stoppage thus produced will occur sooner in large than in small siphons, and in those working more nearly to their limit of lift in the shorter leg than in those that do not approach this limit, and in either large or small siphons it will occur sooner when the flow is remittent or intermittent than when they are kept running to their full capacity.

What has been said with reference to free gas taken into the supply end of a siphon, applies, in the main, also to gas which is dissolved in water, air being the gas most commonly present. Water freely exposed to air always contains a certain quantity of air dependent upon the temperature and atmospheric pressure. Any one can prove this by heating in a glass vessel water that has been exposed to the air. As the temperature rises the entire inner surface of the heated vessel below the upper surface of the liquid will be covered with small air bubbles formed from air driven out of the water. The following table compiled from 'Bunsen's Gasometry" shows amounts of air dissolved at different temperatures by air, under pressure of the atmosphere, at sea level, or a pressure of 0.76m. of mercury column, the volume of the absorbed air being what it would have at the same pressure and at a temperature of 32° F. or 0° C. In this table is indicated the amount of air (the volume of water being taken as unity) which will be absorbed

1	2	3	4
0° C.	0.02471	10° C.	0.01953
1° C.	0.02406	11° C.	0.01916
2° C.	0.02345	12° C.	0.01882
3° C.	0.02287	13° C.	0.01851
4° C.	0.02237	14° C.	0.01822
5° C.	0.02179	15° C.	0.01795
6° C.	0.02128	16° C.	0.01771
7° C.	0.02080	17° C.	0.01750
8° C.	0.02034	18° C.	0.01732
9° C.	0.01992	19° C.	0.01717
.....	.....	20° C.	0.01704

at the temperatures given in columns 1 and 3, the absorbed volumes of air being indicated in columns 2 and 4, these volumes being those which the absorbed air takes at 0° C., and at a pressure of 0.76m. of mercury.

It must be remembered that air set free in the upper part of a siphon will immediately take a larger volume than it would have at the level of the inlet end of the tube or pipe. The increase of volume practically accords with the law of Boyle and Mariotte, which is expressed in the equation,

$$P_1 V_1 = P_2 V_2,$$

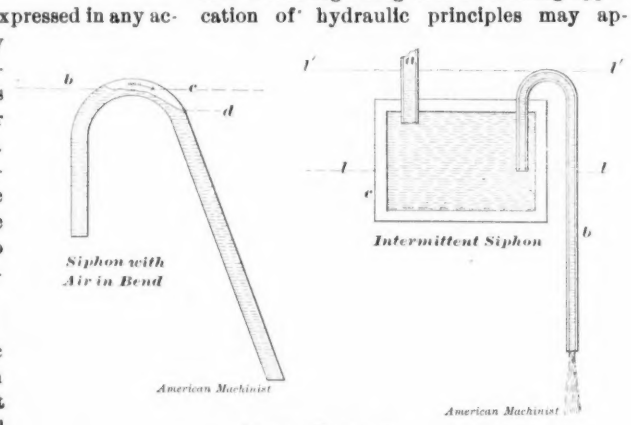
in which P_1 represents a pressure per square inch equal to that of a column of mercury 0.76 meters in height, and V_1 represents a unit of volume, say, a cubic inch; while P_2 and V_2 represent, respectively, a pressure higher or lower than P_1, and a volume which V_1 will take under the pressure P_2, the temperature remaining constant. We may therefore write, assuming V_1 to be one cubic inch,

$$0.76 = P_2 V_2 \text{ or}$$

$$\frac{0.76}{P_2} = V_2 \text{ in cubic inches.}$$

This expression may be interpreted as follows:

Atmospheric pressure expressed in any accepted units, divided by any other pressure expressed in similar units gives volume at the latter pressure in cubic units. For instance, if we suppose the internal pressure at the highest point of the siphon to be reduced to 0.19m. of mercury column, we shall find $\frac{0.76}{0.19}$ as the space in cubic inches that one cubic inch of air entering the inlet of a siphon at sea level will fill at the pressure named, when its temperature remains the same as at the inlet.



About Siphons.

Now, the table of absorption given above shows that at 0° C. water freely exposed to air absorbs 0.02471 its volume of air; and if the supposed siphon be transferring water at this temperature, each cubic inch of air would increase to four cubic inches, if it were set free at the upper bend. If 1,728 cubic inches of the liquid pass this bend per minute, then,

$$1{,}728 \times 0.02471 \times \frac{0.76}{0.19} = 10.674$$

cubic inches will be the volume of air that will pass with the water, provided the air be swept on and discharged at the outflow. In a 1½ inch pipe this would prove fatal to the operation of a siphon in a very short time, were the air immediately set free under the reduced pressure. Fortunately, a considerable time is required for the escape and massing together of the, at first, almost infinitely small globules of air which form with the diminution of pressure, and thus a large portion of them never escape, but being carried over the bend toward the outflow are re absorbed as the pressure upon them increases again on their approach to the outflow. It is easily seen that the slower the velocity of the flow the greater will be the opportunity for the escape of the air and its accumulation in the bend.

The condition in the bend will, under such circumstances, after a time become nearly that shown in the diagram, where the line $b\ c$ shows the height at which water stands in the shorter leg, the height in the longer leg being at d, while a thin rivulet of water will run over the lower part of the bend. After a time the columns in the two legs will separate more, and water no longer flowing over the bend, the column in the longer leg (unless the latter has a small enough caliber to hold the column solid by capillary action) will break, and running out allow air to pass into the discharge end of the siphon, if this end be above water, and the flow will then entirely cease. If the outflow end be submerged, the final cessation of flow will be somewhat deferred, but it will be certain in any siphon carrying ordinary water whose mean rate of flow is not rapid enough at all times to sweep the air out of the bend.

If the flow in an operative siphon be stopped by closing one end only, air will accumulate in the bend, enough water being forced out of the open end to make place for the accumulation; but it will take considerable time for this to prove obstructive when the siphon is again set to work. If both ends be stopped off while the bend has very little or no air in it the air will be retained in the water. Thus, a siphon may become inoperative while not working by leaving either end unstopped; and the mere fact that the unstopped end be submerged will not prevent this occurrence, provided the siphon be left in this condition long enough. This point is not, I believe, generally known; but in the use of siphons working at nearly the limit of lift in the shorter leg, I have had them become inoperative from this cause several times after standing idle for weeks, although the flow was stopped by a cock at the supply end and the discharge end remained submerged. In some applications intermittent siphons are useful as in automatic flush traps, etc. A few words regarding this interesting application of hydraulic principles may appropriately conclude this series of articles.

The construction of an intermittent siphon is shown in the diagram; in which a represents the inlet, b the outlet siphon, and c the chamber from which water or other liquid is to be discharged intermittently. The water level at the lower end of the short leg of the siphon is indicated by the line $l\ l$; the level when the siphon is filled is indicated by the line $l'\ l'$. The liquid flows in at a, rises from the level $l\ l$ to $l'\ l'$, and then flows through the siphon till the level is brought down to $l\ l$ again.

It is evident that, if the inflow in any given time be as great as the outflow in the same time, the action of the siphon will not intermit. Also, if the inflow be infinitely slow, the discharges and intermissions can only take place at infinitely long intervals. From this it may be inferred that there must be some relation between the rates of inflow and outflow which, when established, will make the intervals between discharges a minimum.

Our first inquiry will be regarding this relation; and in conducting it the following notation will be found convenient:

Let T represent the duration, in seconds, of the interval between discharges; t_1 the time, in seconds, necessary to fill the chamber c from the level $l\ l$ to $l'\ l'$; q the quantity in cubic inches necessary to fill the chamber, and t_2 the time necessary to discharge the quantity q from the siphon b.

Case 1.—The outflow is greater than the inflow, else the siphon will not intermit its flow. The inflow is at a constant rate.

The quantity q runs in in t_1 seconds; therefore $\frac{q}{t_1}$ = rate of inflow.

The quantity q siphons out in t_2 seconds; therefore $\frac{q}{t_2}$ = rate of outflow.

While q runs out, $\frac{q\,t_2}{t_1}$ runs in again, and

$$\frac{\frac{q\,t_2}{t_1}}{\frac{q}{t_2}} = \frac{q\,t_2^2}{q\,t_1} = \frac{t_2^2}{t_1}$$

which is the time in which the quantity $\frac{q\,t_2}{t_1}$ will siphon out.

While $\frac{q\,t_2}{t_1}$ siphons out, $\frac{q\,t_2^2}{t_1}$ will flow in; therefore,

$$\frac{\frac{q\,t_2^2}{t_1}}{\frac{q}{t_2}} = \frac{q\,t_2^2}{q\,t_1} = \frac{t_2^3}{t_1}$$

which is the time in which $\frac{q\,t_2^2}{t_1}$ will siphon out.

If now we equate with T the several times of outflow, together with the time of inflow, we shall gain an expression for this interval, which evidently must be the sum of the time it first takes for the chamber to fill plus the total time of running out. We have therefore

$$T = t_1 + t_2 + \frac{t_2^2}{t_1} = \frac{t_2^3}{t_1}, \text{ etc., indefinitely.}$$

Inspection of this series shows that the common ratio is $\frac{t_2}{t_1}$. Therefore,

$$T = \frac{t_1}{1 - \frac{t_2}{t_1}} = \frac{t_1}{\frac{t_1 - t_2}{t_1}}.$$

We may therefore write,

$$T = \frac{t_1^2}{t_1 - t_2} \qquad (1)$$

Differentiating this we have,

$$d\,T = \frac{(t_1 - t_2)\,2\,t_1\,d\,t - t_1^2\,d\,t}{(t_1 - t_2)^2} \qquad (2)$$

Hence,

$$\frac{d\,T}{d\,t} = \frac{(t_1 - t_2)\,2\,t_1 - t_1^2}{(t_1 - t_2)^2} = 0 \qquad (3)$$

$$(t_1 - t_2)\,2\,t_1 - t_1^2 = 0 \qquad (4)$$

$$2\,(t_1 - t_2) - t_1 = 0 \qquad (5)$$

$$2\,t_1 - 2\,t_2 - t_1 = 0 \qquad (6)$$

Therefore,

$$t_1 = 2\,t_2 \qquad (7)$$

This value of t_1 is positive, and hence it is the value of t_1 in the function of T when the latter has a minimum value. Hence the interval of discharge will be the smallest possible when the rate of inflow is half that of the outflow; and this is true for all capacities of the chamber and rates of outflow whatever they may be.

Case 2.—The inflow also intermits.

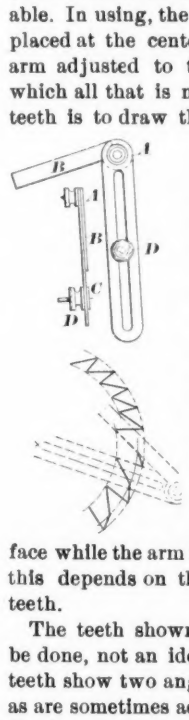
The rates of inflow and outflow for a minimum interval between the beginnings of two consecutive outflows or their terminations being as 1 to 2, it follows that whether the inflow intermits or not, the relation between the mean rate of the inflow (including the time of intermission) must be ½ that of the outflow; and if we write t' as the symbol for the time of actual inflow, and t'' as the symbol for the time during which the inflow intermits, we shall have $t' + t'' = 2\,t_2$.

A Handy Drawing Instrument.

By Fred H. Colvin.

For any one having such work as laying out teeth of any kind, either on the drawing board or in the shop, considerable time can be saved by using the little instrument shown with this, which can be made very cheaply by any one at all familiar with tools.

The usual way is to draw the outside circle, space it off the required number of teeth, draw the inner circle representing the base of the teeth, and after drawing the angles desired for the face and back of one tooth, lay off the spaces on the inner circles proportionately far apart, so as to make the required inclination or angle all the way round. With this instrument, the outer circle can be drawn, divided, and the inclination determined on as in the first case, then this little tool comes into play and makes the inner circle unnecessary in most cases, and in any case does away with the inner divisions of the circles. A strip of sheet brass or German silver, about $\frac{1}{32}$ thick, and in my case, 5 inches long by $\frac{3}{4}$ wide, is slotted nearly the whole length, as shown, and at the upper end a hole drilled for the clamp and nut shown at A, for clamping the arm B in any position. This arm is made as shown, and hinged on the under side of the main piece, as shown in the side sketch, the thickness of the arm and the under flange of the needle point screw C being made the same as shown. The needle point is held in a screw which is clamped to the main piece by the thumb nut shown at D, the needle point being held by friction in the screw just mentioned. The slot allows complete adjustment of the needle point so as to accommodate any sized circle within its range, which is considerable. In using, the needle point is, of course, placed at the center of the circle, and the arm adjusted to the required angle, after which all that is necessary to complete the teeth is to draw the lines by the arm and move the instrument to the next notch, and so on until completed, then moving the arm to the other angle of the tooth, and drawing from the same point, the crossing of the lines shows the bottom of the teeth, without any circle being drawn or divisions made. In some cases the main piece will come right so as to be used, as shown by the dotted lines, in drawing one side of the face while the arm draws the other side, but this depends on the angle chosen for the teeth.



The teeth shown merely show what can be done, not an ideal tooth, and the lower teeth show two angles on the back side such as are sometimes adopted for milling teeth. To those whose work warrants such an instrument I can heartily recommend it as very useful and labor-saving, and the cost is trifling, but to the man who never has any work of this kind, I would say don't fill your kit with it, for it is not one of these universal arrangements that will draw perfect ellipses, cycloids, etc., by changing the set screws.

The Compression Curve.

By Frank H. Ball.

In the American Machinist of January 11th, Professor Webb gives a graphical method for determining the most economical compression curve for any given expansion curve. His method is briefly as follows:

Referring to Fig. 1 (page 5), let $B\ C$ represent a given expansion curve for which it is required to select the most economical compression curve.

Produce the expansion curve from C to M, where it intersects the continuation of the back pressure line $E\ D$. Next, draw the line $S\ T$ parallel to $E\ D$, so that the area $A\ B\ T\ S$ shall equal $C\ M\ D$.

Then Professor Webb tells us that $N\ S$ will be the most economical compression curve. The same conclusions are reached by Professor Cotterill, in his work entitled "The Steam Engine." It must be admitted that Professor Webb's method is a very clever one for reaching this result, but does it give the most economical compression curve? An answer to this question will be sought in the following investigation:

In considering the effect of compression, the question may be variously stated as follows:

1. Required to construct the expansion and compression curves of a diagram so that a given M. E. P. may be most economically obtained.

2. Required to locate a compression curve that will correspond in economy with a given expansion curve.

3. Required with a given expansion curve to locate the most economical compression curve.

The last proposition is the one Professor Webb seeks to solve.

It is the most difficult of the three, because a correct solution cannot be obtained without introducing into the problem the modifying effect of cylinder condensation, and even with an engine having no cylinder condensation, the demonstration would have no practical value, because, as will be

shown further on, the same M. E. P. can be obtained with a smaller consumption of steam by locating both the compression and expansion curves so that they shall bear another relation to each other, which relation will also be defined and explained.

It will further be shown that the first two propositions of the compression curve problem as stated, are easy of solution by the method just mentioned, and when solved by this method, the result holds good without any regard to cylinder condensation, while Professor Webb's method does not solve any of the three propositions when applied to the real engine, with which we have to deal.

Referring again to Fig. 1, and resuming the consideration of Professor Webb's method, he undertakes to prove that *N S* is the most economical compression curve by showing that if this curve is moved in either direction, and the resulting area of useful diagram is divided by a line corresponding to *N M*, the quotient in every case will be less than when the curve is located as shown. In this demonstration he compares the areas of diagrams representing different amounts of work without considering the consequent modifications imposed by cylinder condensation. The possible error of disregarding so important a factor will appear in the following comparison between Figs. 1 and 2.

Area of *A B M N* (Fig. 2)..... .66″.
Length of line *N M*..... 1.12″.

$$\frac{.66}{1.12} = .58.$$

By the same method applied to Fig. 1,
Area of *A B C D N*..... 2.04″.
Length of line *N M*..... 4.34″.

$$\frac{2.04}{4.34} = .47.$$

If diagrams representing different amounts of work may be compared by Professor Webb's method, then it has been demonstrated by the above that the diagram of Fig. 2 is the most economical.

Let us see how this corresponds with facts that are obtained in engine trials.

Fig. 3 is a graphical representation of the performance of an 80 horse-power single cylinder automatic cut off engine tested under varying loads by Professor Carpenter, of Sibley College, Cornell University.

This test is fully reported in Vol. XIV of the "Transactions of the American Society of Mechanical Engineers," from which Fig. 3 has been copied. Referring to Figs. 1 and 2, the M. E. P.'s represented by these diagrams are, respectively, as follows:

M E. P. of Fig. 1..... 33.6 lbs.
M. E. P. of Fig. 2..... 13 2 lbs.

In the engine tested by Professor Carpenter, which furnished the data for Fig. 3, the consumption of steam per I. H. P., with 13.2 M. E. P., was more than 40 pounds, and with 33 pounds M. E. P., less than 31 pounds per horse power per hour. Reviewing then, it would appear that by using Professor Webb's method of comparing the diagrams of Figs. 1 and 2 the latter is supposed to require 23 per cent. less steam per horse-power per hour than the former, but by the figures of actual tests, it uses about 33 per cent. more steam per horse-power per hour than Fig. 1.

This enormous difference represents the possible magnitude of the error that is included in any theory for comparing the relative economy of diagrams of different areas, if cylinder condensation is neglected, and Professor Webb's conclusions are, therefore, not correct when applied to the engine tested by Professor Carpenter.

Continuing the investigation, let us assume an imaginary engine in which cylinder condensation does not occur. With this engine Professor Webb's demonstration would apply, and his conclusions, as represented by the diagram of Fig. 1, would satisfy the requirements of the third proposition with which we started out, but it will now be shown that even with this impossible engine that has been assumed the same amount of work may be realized from a smaller amount of steam than the line *N M* represents, if the expansion and compression curves are both located according to a law suggested in a paper read before the American Society of Mechanical Engineers, and published in Vol. XIV of their transactions beginning on page 1067.

This law may be briefly stated as follows:

Whenever the area of any diagram exceeds the area of theoretically perfect diagram *A B M N*, Fig. 2, then this excess of area must be distributed along both the expansion and compression curves in such a manner that the useful areas added along each curve shall be accompanied with the same proportionate loss by free expansion at exhaust opening and in the clearance space, this free expansion being measured by the areas of the diagram which extend beyond the limit of piston travel, as *C M D* and *H A F*, Fig. 4, which diagram has been produced by the method just described. Fig. 1 has already been described as a diagram produced by Professor Webb's method, and its area of 2.04 inches divided by the length of the line *N M* equals .47, as already stated. The area *A B C D N*, Fig. 4, is also 2 04 inches, but the length of the line *N M* is only 4.18″, instead of 4.34″, as in

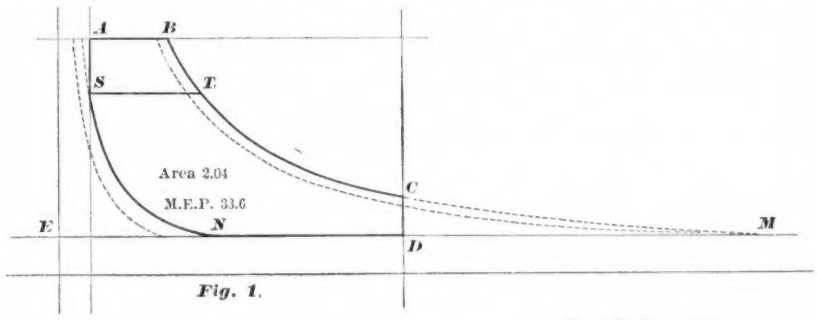


Fig. 1.

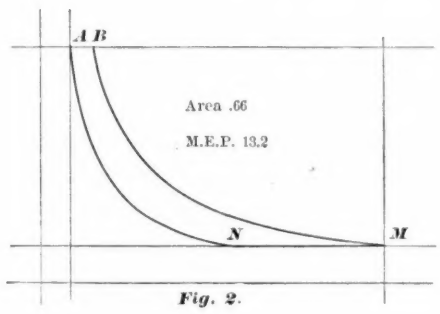


Fig. 2.

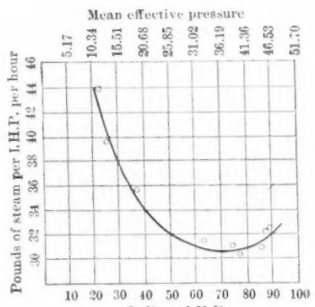


Fig. 3.

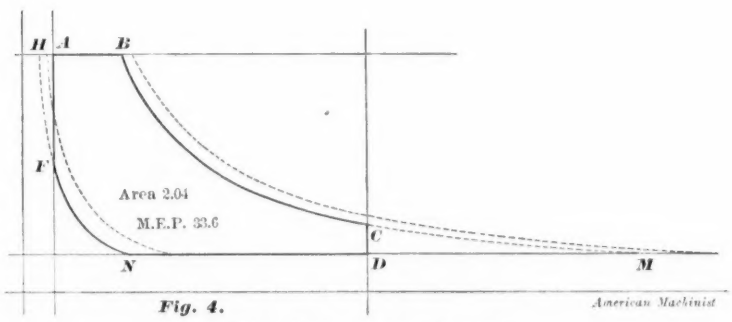


Fig. 4.

THE COMPRESSION CURVE.

Fig. 1, and by the method applied to the consideration of Fig. 1, we have

$$\frac{2.04}{4.18} = .488$$

and, therefore, the diagram of Fig. 3 is the more economical, because it develops the same M. E. P. as Fig. 1 from a smaller consumption of steam.

Any diagrams constructed by this method will satisfy all the requirements of the first two propositions with which we began, and will fit every case without regard to what the cylinder condensation may be.

In conclusion, then, it may be said in regard to Professor Webb's method:

I. That it does not give the most economical compression curve when applied to the real steam engine with which we have to deal, because it disregards the loss by cylinder condensation.

II. That a diagram produced by his method, if greater than *A B N M*, Fig. 2, does not indicate a given amount of work with the smallest consumption of steam, and is, therefore, not the most economical, even when applied to the impossible engine which it assumes.

55,768,000 bushels of grain were exported from New York in 1893; all in foreign vessels.

LETTERS FROM PRACTICAL MEN.

Chemistry (and Other Things) in Melting Iron.

Editor American Machinist:

The treatment of the question in regard to oblong furnaces by Mr. West, March 8th, does not by any means agree with our practice in smelting, and the "bunging up" of a furnace can be traced directly to its mismanagement. When material is properly handled, it cares very little whether the furnace is square, round, or otherwise, that it melts itself in. This I know from sad experience, and one can hardly realize the change that has come about in the last few years. With coke from $15 to $60 per ton, fire-brick 10 to 40 cents apiece, labor $1 per day, mechanics $5 and $6 per day, chemists and superintendents $150 to $300 per month, and other expenses in proportion, you can perhaps imagine the scheming going on to meet a pay day every month for 40 to 60 men. Furnace after furnace was built and tried; some were good, and some otherwise. They were of rock, of brick, and of iron, all shapes and sizes, with and without boshes and tuyeres. High up and low down, some with cooling arrangements, all kind of wind machines and patent appliances; in fact, anything that came along we have tried, or seen tried by our neighbors, that could be bolted on or attached to a furnace (sheriff included). This paper could be filled with the history, but will merely state that from 20 to 25 tons per day through a 36 inch round furnace, employing 40 to 60 men, we increased to 35 and 40 tons in a 33x84 furnace, and then by mixing in a small amount of chemistry (I took a two weeks' course for $25 at about this time) with our charges, we increased to 60, then 75, then 90, and 95 became a daily run, with from 21 to 33 men, one day running 105 tons. We smelted everything, even to tons of fire brick and clay from old furnaces. Where it took 5 to 10 days to get the furnace going decent, and at an expense of from $500 to $600, and expecting 28 to 30 days' run, we now start for $20, and get a regular day's run in 24 hours, and keep in blast 70 to 90 days. From such an experience, if I were called upon to melt a large amount of iron, and knew that the blast would not penetrate to the center of a round furnace, I would not hesitate two minutes to put in an oblong furnace long enough to do the work. The large outputs of the blast furnaces of late years have come about by mixing a little chemistry in their charges, and this was occurring at about the same time as the smelters were trying to solve the same problem, and I am inclined to believe that the smelters were ahead, so why should not a little chemistry help the foundry men?

Oakland, Cal. P. C. FORRESTER.

A Cost-keeping System.

Editor American Machinist:

The system described in the AMERICAN MACHINIST of February 8, 1894, by Walter B Snow, has many good features to commend it, and as he does not claim it to be perfect, I will not specially criticise it, but will use it as a basis from which to make some observations on the great difficulty of effectually carrying out an efficient system in some classes of machine shops.

The kind of shop which presents the most difficulty, is one that has several varieties of regular work which is made sometimes in lots of several of one size, and sometimes only one at a time, along with special machinery built to order, and a great variety of jobbing and repair work.

When the work is moving along at a moderate pace with production within the capacity of the shop without crowding, then almost any kind of a cost system will answer the purpose, if it is devised with its purpose in plain view at the time, but when times get good, and orders gain on production, until overtime and perhaps double time is required to keep up with orders, and keeping a stock ahead for repairs is impossible, then the system is apt to prove inadequate, and fail for lack of adaptable flexibility. The keeping of a daily total time account for each man presents no special difficulties, and can be kept as suggested, by a check system, or other ways equally accurate and efficient.

It is assumed that a good working system of wages cost must show the time required to perform each different machine operation and the hand work on each piece until completed, with the rate of wages for each operation. In many cases it is also required to know the particular machine the work is done on, as the first cost and the power cost of the machine is a factor in the cost of the work done.

It is absolutely essential that some plan of ordering and identification of orders be adopted, so that the identity of each piece or lot of pieces may be kept until finished. The consecutive numbering of each completed machine is generally sufficient to answer this purpose, if, in addition to this, there be some symbol to indicate the kind and size of machine. At this point I wish to question if it is best to adopt a system of order numbers for what Mr. Snow terms production orders, with no distinction from the selling order number, but the letter p preceding the order number. I think this is liable, in some instances, to cause confusion of time on the cards, on account of getting time charged to one kind of order that should belong to the other. To obviate this, lot numbers could be adopted for each new lot of one kind and size of machine, and the time card be headed, "Time Card for Stock, on Lot No. ——.

To make a time-keeping system reasonably accurate and valuable, it is essential that it be under the direct supervision of whoever has the most thorough knowledge of how the work is going through the shop, and he should be held responsible for keeping the system up to the degree of accuracy desired. As the foreman knows the most about how the work is going, he should be the one to have charge of the time system, but this duty must not be imposed on the foreman to the detriment of his other duties, as I have known it to be, but he should have an assistant or clerk working under his immediate direction, to do the detail work, that would otherwise interfere with the legitimate duties of the foreman.

It is possible for a timekeeper to do it

without the supervision of the foreman, but to do it right, he would need to be as well informed of the run of the work going on, as the foreman is, or he would be liable to make many mistakes.

The method of keeping a time card with each job, or each lot of similar pieces, has been very satisfactory in several places, but it has some faults which are not easily overcome.

1. When several men work on the same piece or lot of pieces at different times, as often will happen on double time, or in case of sickness, discharge or leaving of workmen, the card must be provided with space for adding the name and separate time of each man on the job, or a new card must be made out for each man. In either case it must be looked after by the timekeeper or foreman frequently, or there will be part of the time omitted by thoughtless workmen.

2. It sometimes occurs that one operation is completed on only a part of a lot, or only part of the operations are completed on the whole lot, and they are then laid aside for a long time. It is then very important to have these pieces marked with the lot number, or otherwise identified so that they do not get mixed up with a new lot of the same pieces which may come in, and have work started on them before the first lot is completed. I know of one shop where about four months of time record was rendered almost worthless on account of confusion caused by the loss of identity of lot numbers and failure to put them on the time cards. It may be argued that the time record can be kept all right by using a consecutive machine number, but it would be rather expensive to mark every piece that belongs to a machine with the consecutive number. There is another objection to using the consecutive machine number on each piece which will appear later.

3. Considerable work is sometimes done on a piece and it shows some defect which condemns it.

Some way must be provided to keep account of the time on such work so it will not be charged in with the lot. Also, when work is spoiled by a mistake or bad workmanship it comes under the same head. The time system must not only give the total cost, including mistakes and work on defective material, but keep the account in such a way that the extra cost can be easily separated from the legitimate.

4. Every shop is liable to frequently have repair orders which are in a hurry, and sometimes the stock on hand to fill repair orders is exhausted, and it is necessary to take a piece from a regular lot which is going through the shop to fill the repair order. Very frequently only the one piece taken will be finished up at the time, and this leaves a gap in the lot which, if the piece had been numbered with the consecutive machine number to which it belongs, will have to be filled with a new piece taking the same number in order to keep the correct amount of pieces in the lot. Here, then, will be the full time for two pieces represented by a single number on the records, which is a serious objection to the plan of keeping the identity by giving each piece the consecutive number of the machine to which it belongs.

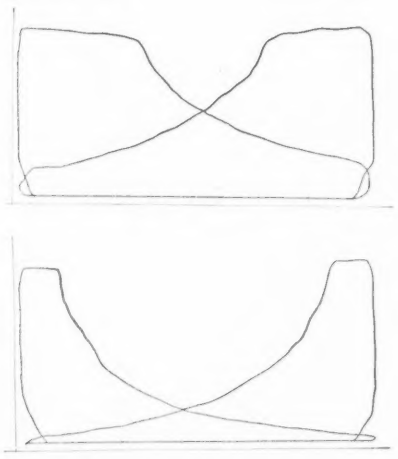
When the foreman alone is required to see that the time cards are made out properly, the only way a decent degree of accuracy can be had, is by the plan of giving with each job the card which belongs to it, noting the date and hour given, the workman being required to return the card to the foreman as soon as he ceases work on the job, the foreman then noting the date and hour when he ceased working on the job; or, the workman may do this himself, the foreman simply inspecting it to see if time is noted correctly. Even this will not keep the time correct if the time extends over one day, unless time which may be lost by workman between time of starting on the job and ceasing work on it be always noted by the foreman. With this precaution objection No. 1 may be overcome.

For overcoming the other objections I have not yet discovered any system that is more effective than that of having the foreman or timekeeper made responsible for noting on the time cards the desired information so clearly that it will be understood, and making him responsible for the identity of lot numbers and piece numbers with the time reported on them.

When the time is once correctly secured on the cards the plan of filing in envelopes under the order or lot number is excellent, and does away entirely with an elaborate system of posting cost books.

The time that would be spent in posting into books could be spent to much better advantage in securing an accurate entry of the time on the cards in the shop.

If Mr. Snow has met and overcome some of the objections herein pointed out, I would be, and I think some of your other readers would be interested in hearing from him regarding it. BELL CRANK.



Cards From a Reynolds-Corliss Engine—A Special Chucking Device.

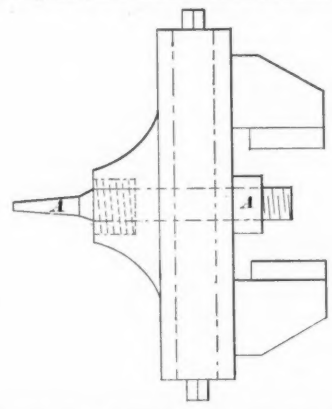
Editor American Machinist:

I inclose with this copies of some indicator diagrams taken about a year ago from a Corliss engine, made by E. P. Allis Co., and while they are not submitted as ideal cards, the conditions make them worthy the examination. The engine is an 8x24 noncondensing, and is in one of the worst places imaginable, being in a cellar next to the boiler, and subject to the siftings through a poorly laid floor above, the room above being used until within a year or two for cleaning castings, rumbling, etc., and not the best kind of dirt to have in the engine room.

The engine has hardly ever been cleaned, and the oil is burnt on till it looks like a paint, the only redeeming feature being that as a rule the throttle opener and closer has kept it fairly well oiled. These cards were taken after 11 years continuous running, without any adjustment having been made to the valve motion, and without the exhaust valve stems being even packed, the speed of the engine started with 65, but has been crowded up until it has been running 100 turns per minute for the past three years. The rest of the engine has also given little trouble, and this has always been attributed to the everlasting fixer, who puts in time on the engine whenever the shop shuts down for a day, and as a result the engine lays down the next day until the fixing is unfixed. Considering all the conditions, I think the cards speak very well, indeed, for the engine with the necessary complications of the releasing gear, and show that they do not always demand as much attention as they receive.

The other cut shows a scheme that has been in use successfully for a number of years for holding work true in the chuck after it has been tapped on one end.

One end is tapped with a rather fine thread (18), and it is necessary that this end be held firmly in the chuck while the other and larger end was being bored and tapped, and although it might seem the proper way to tap the large end first, it was hardly possible in this case, and the plan shown was adopted. The mandrel or guiding arbor *A A* was made to fit the lathe spindle hole as shown, with the length just sufficient to project through the chuck enough to hold the work central while being chucked. The collar on the arbor is flattened for a wrench, and, of course, must be taken out each time with the work, as the jaws prevent its being unscrewed in the chuck. In the first place, the arbor is screwed into the



work and put in place and then the chuck jaws are built up to suit by lining up beneath the jaws, and after the first one is provided the rest come in line without further adjusting. Thus centered the work is tightened in the chuck and firmly held until the other end is finished, when taking out the arbor with the work and screwing it into the next one is all the delay it occasions.

It is possible, if the number of pieces to be done warranted it, to provide jaws for this work without the guiding arbor, but the peculiar shape of the casting and the difficulty of holding it without some such support make this the cheapest method under the existing conditions. It may contain a germ of an idea for some other work of a similar nature. FRED H. COLVIN.

The Speed of Ropes.

Editor American Machinist:

Anything that Mr. Booth has to say regarding rope-driving is always worthy of careful attention, but his condemnation of high rope speeds, in your issue for March 29th, appears to me to be somewhat too sweeping. In the first place, it is well to bear in mind that the choice of speed is not in most cases decided by the caprice of the designer. For the purposes to which rope-driving is most extensively applied—cotton mill and dynamo-driving—the revolutions of the driven pulley have, as a general rule, a more potent influence than any other factor. In the first case we have shafting to drive at, usually, 300 revolutions per minute, and if we are to use $1\frac{3}{4}$ inch ropes, and to adhere to the usual rule of 30 rope diameters for the minimum pulley diameter, we must have a rope speed of $\frac{300 \times 30 \times 1.75 \times \pi}{12} = 4.125$ feet per minute. With a dynamo running at the very moderate speed of 400 revolutions, we have, for the same size of rope, $3{,}140 \times 1.75 = 5{,}496$ feet per minute as the rope velocity. With $1\frac{1}{2}$-inch rope we should reduce the speed to 4,710 feet; with $1\frac{1}{4}$ inch to 3,925 feet, and with 1 inch rope to 3,140 feet per minute. To all these, excepting, perhaps, the last, I presume Mr. Booth's objections would apply, but as he consistently advocates large ropes, and is, I believe, quite orthodox in his choice of pulley diameters, I quite fail to see how he proposes to arrange matters without using high-rope velocities or small pulleys. One of the objections to high speed is, that it entails more frequent bendings of the rope, but if we attempt to obviate this by using smaller pulleys, we certainly lose more than we gain, by the consequent bending of the rope around a smaller radius causing a more rapid internal wear than that which it is sought to avoid.

No hard-and fast rule can be laid down as to the best size of rope to use in all cases. In a large mill engine where considerations of first cost, space occupied, weight of rope, wheel and axle friction, appear to call for as narrow a wheel as possible, we might reasonably expect to find the larger sizes of ropes employed. But, as a matter of fact, there are now few, if any, engine builders in the north of England using 2 inch ropes, while, for what I believe to be the largest mill engine yet constructed—the 4,000 horse-power engine at the Manockjee Petit Cotton Mills in Bombay—64 $1\frac{3}{4}$-inch ropes are used, running at 4,250 feet per minute. On numbers of engines of over 1,000 horse power $1\frac{3}{4}$ inch ropes are used with good satisfaction, and, although this size is not being generally adopted there is a marked tendency in the direction of using smaller ropes than heretofore customary. A few years ago, it was a question of 2-inch *versus* $1\frac{3}{4}$ inch ropes, but now $1\frac{3}{4}$ inch and $1\frac{1}{2}$ inch are the sizes most usually employed, the trend being decidedly towards the use of the smaller size. The speeds most generally adopted lie between 4,000 and 5,000 feet per minute, and I notice that while there are a few instances in which speeds of less than 4,000 feet are used—there are almost as many in which 5,000 feet is exceeded.

In dynamo-driving the conditions are somewhat different. If we use four 2-inch ropes for an electrical unit of 200 horse power, the slight gain accruing from the use of narrow pulleys is discounted almost immeasurably, by the larger diameters necessary both for engine fly-wheel and dynamo pulley. Further, should one of the ropes fail the remaining three will have to transmit the whole of the power for the time being, so that each will then transmit 33 per cent. more than its normal amount of power. On the other hand, if eight $1\frac{1}{4}$ inch ropes are used, the pulleys will require to be about 50 per cent. wider, but only $\frac{5}{8}$ths of the diameter necessary when 2 inch ropes are used. Should one of these ropes fail, each of the remaining seven would have to temporarily transmit only 14 per cent. more than its normal amount of power.

In speaking of the reduction of frictional grip or "adhesion" at high speeds, and the loss of power incurred in pulling the rope out of the groove, Mr. Booth appears to have overlooked one fact, which will, I think, somewhat modify his conclusions. We agree in assuming that the rope is not to be stressed beyond, say, 300 pounds per square inch of section, and from this it follows that as the centrifugal tension increases, the available power-transmitting tension must be diminished correspondingly at speeds sufficiently low to enable centrifugal tension to be disregarded; the difference of tensions on the driving and following sides, T and t, gives the effective power-transmitting tension, while the sum $T + t$ may be taken as representing the pressure forcing the rope into the groove of the pulley. At high speeds the *effective* tension on the driving side $T\,e$, plus the centrifugal tension, is to equal the total tension T. The effective tension $t\,e$ on the following side is also diminished. Now, it appears to me that only the *effective* tensions $T\,e$ and $t\,e$ are now combining to draw the rope into the groove, and these, as just shown, will rapidly decrease in amount as the speed is increased. The effect of centrifugal action on that portion of the rope, which is for the instant in contact with the pulley, is to cause it to move radially outward, and although this will only occur to a slight extent (since the sum of the *gross* tensions is not greatly increased and therefore the stretching of the rope will only be of small amount), it will lessen the frictional grip and probably make the contact line between the rope and pulley groove a circle (actually a spiral) of somewhat larger radius. This outward radial movement is the cause of and is balanced by the centrifugal tension in the two sides of the rope. It follows from this, that at high speeds, although there is more rope to be pulled out of the groove per minute, yet if the foregoing reasoning is sound, the work done in releasing the rope is very much reduced by reason of the radial centrifugal action referred to. Finally, it may be questioned whether the loss due to this cause, at fairly high speeds, is not altogether overrated. With a rope reasonably lubricated it would not appear to require a very great effort to release the rope from the driven pulley, and

it is at that point that the greatest loss occurs.

I think Mr. Booth's ratio of tension of 10 is altogether too high. Twenty per cent. for the slack side tension appears to be as little as can reasonably be counted upon with a groove angle of 45 degrees and ordinary conditions of working.

Regarding the weight of cotton rope, I have found from a number of examples that the average weight per foot is about 0.3 diameter. Some makers are not above weighting their ropes with white lead and otherwise adulterating them with the object of saving yarn. Such a practice has a threefold deleterious effect upon the working. In the first place, it detracts directly from the strength of the rope; secondly, it increases the centrifugal tension per unit of *stress resisting area*, and, thirdly, the weighting material rapidly hardens and much increases the resistance to bending, thereby directly diminishing the efficiency of the transmission. In order to more fairly compare the strength of driving rope, Kirkaldy, in his system of mechanical testing, has adopted the method of expressing the tensile strength in *stress per fathom weight*, that is,

$$\text{tensile strength} = \frac{\text{breaking stress}}{\text{weight of 6 feet of rope}}.$$

In this way, with the same yarn, the adulterated rope will show to great disadvantage as compared with a rope of equal diameter made purely of yarn, since, in the first case, the numerator of the fraction will be decreased, while the denominator will possibly be increased. The weights of honestly made ropes of the same material and diameter should not differ to any material extent, and while it is unquestionably desirable to obtain ropes of the smallest possible weight for a definite ultimate stress, power users will be well advised to carefully investigate the claims of the makers of loosely twisted "light" driving ropes. M. E.

Traction Engines.

Editor American Machinist:

Under the above caption appears an article in your issue of April 26th, which is somewhat misleading, inasmuch as it creates the impression that the steam engine indicator is rarely applied to traction engines, and that "when you apply an indicator to a traction engine you run up against engine and boiler design combined."

Now, I know of a concern building traction engines in great numbers, and each one is carefully tested not only for "traction appliances," but for steam distribution as well. A record of these tests, including an indicator diagram, is carefully filed and now comprises about 7,800 separate reports covering a period of many years. At this place the steam engine indicator is a very common instrument, and it as well as its marks are tolerably well understood by a large number of the workmen, the mystery surrounding it in the early seventies having long ago vanished.

Draught gauges, pyrometers, tachometers, and dynamometers are in daily use, and if the traction engine does not show any improvement as a result, then the task of improving it is a hard one. But few traction engine builders retain the link, a majority of them having discarded it years ago, and thousands of these engines are being put out every year with a reversing device more or less simplified both as to first cost and subsequent cost of maintenance. The excessive wear of the link over dusty country roads early suggested its retirement, and the inventor responded with promptness and more or less success.

Touching on boiler explosions, I believe that considering the large number of traction engines in daily use their percentage is no higher, if as high, as in boilers used for other purposes.

These remarks have not been made to find fault with or antagonize any one, but with a desire to call attention to the fact that the world is moving even among builders of traction engines.

Massillon, O. CHAS. O. HEGGEM.

Blow-holes in Castings.

Editor American Machinist:

I have been much interested in the articles which have been published in your columns lately, in answer to the query of Mr. Drake as to the possibility of blow-holes being caused by defects in the pig iron.

I will take a more decided stand than other writers on this subject have, and say that it is impossible for the above to occur.

In the first place, the impurities found in pig-iron, such as sulphur, phosphorus, silicon and manganese, form slag, and the small percentage of gas which is also in the iron will combine with this and pass off in a liquid state or form a dirty substance on top of the ladle.

In the last five years I have used over thirty different brands of pig-iron, together with about 25 per cent. of sprues and scrap, and find that all of these when melted with coke to a high temperature will boil in the ladle and form gas bubbles. These bubbles are, in my theory, what Mr. Drake calls blow-holes.

To prevent these from appearing in the castings, the iron should be poured as soon as possible and while the gas bubbles are coming to the top of the ladle, the motion of pouring causing them to pass off. The molds should have small gates and large basins, which should be kept full while pouring. If the iron is allowed to rest and cool to a low temperature, only part of the gas bubbles pass off, the rest sinking and being poured with the iron into the mold.

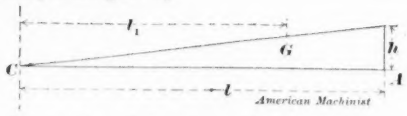
Now, to prove that the iron did not cause the bubbles, I tried the same brands melted with Lehigh coal and found that there were no bubbles at all in the ladle, the iron simply frying and having a shiny surface, thus showing that the bubbles were caused by the sulphur and other impurities in the coke.

The above ideas are nearly the opposite of those expressed by other writers, but I have found them to be thoroughly practicable. J. F. H.

The Gravity Problem.

Editor American Machinist:

Mr. Leicester Allen's problem in your issue of April 26th can be easily solved by considering a piece of metal without thickness, and by letting unit of area be unit of weight, and the solution is independent of the specific gravity.



For a free fall of one foot, we have $t = \sqrt{\frac{2}{32.2}} = \frac{1}{4}$ second about. If G is center of gravity, $l_1 = \frac{2}{3}l$, and moment of gravity about $C = \frac{2}{3}l \times \frac{l\ h}{2} = \frac{l^2\ h}{3}$. Moment of inertia about $C = \int_0^l \frac{h}{l}\ x^3\ d\ x = \frac{h l^3}{4}$.

Now, linear acceleration $= g\ l \times \frac{\text{moment of force}}{\text{moment of inertia}}$;

therefore, acceleration of $A = g\ l \times \frac{l^3\ h}{3} \times \frac{4}{h\ l^3} = \frac{4}{3}g$, and time of descent of $A = \sqrt{\frac{2}{3}} \times \frac{1}{4} = .22$ second. If the figure turns about A, moment of gravity $= \frac{l}{3} \times \frac{l\ h}{2} = \frac{l^2\ h}{6}$. Moment of inertia $= \int_0^l \frac{h}{l}(l - x)\ x^2\ d\ x = \frac{h\ l^3}{12}$, and acceleration of $C = g\ l \times \frac{l^2\ h}{6} \times \frac{12}{h\ l^3} = 2g$, and time of descent $= \sqrt{\frac{1}{2}} \times \frac{1}{4} = .18$ second.

AN OLD BOY.

A Dangerous Emery Wheel.

Editor American Machinist:

In looking over some old AMERICAN MACHINISTS, in the issue of April 12th I notice a communication from "Safety." This description of an emery wheel is an exact duplicate of a wheel that came under my notice last summer, and with most fatal results. The operator had cut off with a chisel a piece of lathe tool steel $\frac{1}{4}$x1$\frac{1}{4}$, and had stepped to this new wheel to take off the ragged edges, and round the corners; he had hardly touched it before the wheel burst, killing him instantly. One piece of the wheel had pulled out from the cast-iron hub, and the balance of it had stripped off flush with the hub all the way around. The pieces showed, what I called, very poor heating, and the mixtures seemed coarse and uneven. The emery was not let into the hub more than $\frac{1}{4}$ of an inch. What started it, no one could tell, he did not put enough pressure on to break an ordinary wheel, as the size of the tool ground would indicate. The operator had bought this sample wheel at a reduced price of an agent a few days previous, and it was to be used as a test, and if satisfactory, orders were to be placed for more. Where it was made I never knew. FRANCIS F. PRENTISS.

Cleveland, O.

The Montreal Meeting of the American Society of Mechanical Engineers.

The programme of the forthcoming meeting of the American Society of Mechanical Engineers, which is to be held June 5th to 9th, is at hand. It is expected that a party will leave New York and New England some time Monday morning, the 4th, arriving at Montreal the same evening. Tuesday will be devoted to seeing something of the city, and the opening session of the society will be held in the evening of the 5th, in Molson Hall of McGill University, by courtesy of the governors. Addresses of welcome will be delivered by the Mayor of Montreal; by Hon. Sir Donald A. Smith, LL. D., Chancellor of the University; by Prof. H. T. Bovey, LL D, Dean of the Faculty of Applied Science; and by Herbert Wallis, Esq., Chairman of the Local Committee. After a response by President Eckley B. Coxe, the usual preliminary business of the society will be taken up, after which professional papers will be presented. Papers will be presented during the meeting as follows:

"Notes on the Theory of Shaft Governors," by A. K. Mansfield.

"Heat Units and the Specifications for Pumping Engines," by Albert F. Hall.

"A New Recording Pressure Gauge for Extremely High Ranges of Pressure," by W. H. Bristol.

"A Note on Compressed Air," by Frank Richards.

"The Relation of the Drawing Office to the Shop in Manufacturing," by A. W. Robinson.

"The Theory of the Steam Jacket; Current Practice," by R. H. Thurston.

"Results of Experiments with a 50 Horse-power Single Non-condensing Ball & Wood Engine to Determine the Influence of Compression on Water Consumption," by D. S. Jacobus.

"Cylinder Proportions for Compound Engines, Determined by their Free Expansion Losses," by Frank H. Ball.

"A New Method of Compound Steam Distribution," by F. M. Rites.

"Tests of a Small Electric Railway Plant," by Jesse M. Smith.

"Power Losses in the Transmissive Machinery of Central Stations," by W. S. Aldrich.

"Rustless Coatings for Iron and Steel," by M. P. Wood.

"Corrosion of Steam Drums," by Jas. McBride.

"A New Mechanical Fluid," by C. W. Hunt.

"First Stationary Steam Engines in America," by F. R. Hutton.

"Cost of an Indicated Horse-power," by DeCourcy May.

"A New Form of Canal Waste Weir," by John R. Freeman.

"Effect of Varying the Weight of the Regenerator in a Hot air Engine," by G. W. Bissell.

"Mechanical Draught for Boilers," by W. R. Roney.

"The Saturation Curve as a Reference Line for Indicator Diagrams," by R. C. Carpenter.

"Results of Measurement of the Water Consumption of an Unjacketed 1,600 Horse-power Compound Harris Corliss Engine," by Messrs. Denton, Jacobus and Rice.

"Notes on the Corrosion of a Cast Steel Propeller Blade," by F. B. King.

The social features of the meeting will consist of a reception to be tendered by Hon. Sir Donald A. Smith at his residence, 1157 Dorchester street, on Wednesday evening, and a garden party at the house of Mrs. J H. R. Molson, Piedmont Hall, on Friday afternoon. Excursions will be made to various points of interest, including one by courtesy of the Grand Trunk Railway, on Wednesday afternoon, which will go to Lachine. At Lachine wharf a steamer furnished by the Harbor Commissioners will take the party down the Lachine Rapids, below which they will be transferred by steamers to Ile au Herron, where they will land. Afternoon tea will be served on the island, and the Harbor Commissioners' steamers will afterwards convey the party to view the dredging operations in the harbor, finally landing them at the entrance to the Lachine Canal, at the foot of McGill street.

Saturday will be devoted to an all-day excursion to Ottawa, and a visit to points of interest in and around that city.

Topical discussions to be presented during the meeting are as follows:

"Are there certain general principles underlying the proper connection of steam boilers and engines in a power plant?"

"What form of filing cabinet have you found most convenient for clippings, etc.?"

"Can it be made practicable to design a machine which shall unite the merits of both the milling machine and the planer? Is not this problem a paradox in machine construction?"

"For filtering oil having very finely divided metallic particles in suspension, what have you found to be the best filtering material, either for one operation or in a series?"

"What is the economy, if any, of damper regulation in firing with liquid or gaseous fuel?"

"In boilers fired with liquid or gaseous fuel, is there any advantage in simultaneous regulation of the fuel supply and the position of the damper, either by the same or by different mechanisms under the ordinary control of the steam pressure?"

"Are there any conditions under which oil fuel is cheaper than coal for generating steam at points in the Atlantic Seaboard States, if so, what are they, and where?"

"Has any term ever been suggested to discriminate between the elastic resistance offered by a body to a force tending to change its shape and that offered by the same body to a force tending to change its volume? How much of the latter kind of elasticity has India rubber?"

"In a centrifugal pump at constant speed, how is the efficiency affected (*a*) by throttling the deliver, (*b*) by a by-pass?"

"In a centrifugal pump receiving water under a head, does the whole amount of the head add to its normal lift?"

"What is the common method and best practice for determining the largest sizes of pipe desirable to use in mill heating, both by live and exhaust steam?"

"In the operation of annealing tool steel, what is the essential or principal condition to be observed to insure the best success? What is the best telephone system for connecting departments of a large works with each other and the central office?"

"What rule is there for determining approximately the horse-power required to drive disk fans for exhausting and ventilating?

Has any one found it to pay to exhibit in recent International Expositions, where to do so entails a cost of attendance, transportation and other heavy charges?"

"Is there any reliable method of calculating the cost of one machine if the cost of a larger number is known, or conversely, if you know the cost of one machine, can the cost of building a larger number of the same machine be satisfactorily calculated?"

"What information can you give as to the best method for the extraction of oil from condensed steam, where it is desirable to use the exhaust steam repeatedly for boiler-feed purposes?"

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NEW YORK, MAY 17, 1894.

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A Sample Steal.

One is strongly reminded of the old saying regarding the falling out of rogues by some recent occurrences in connection with the financial management of the Northern Pacific Railroad, illustrating again the fact that much that is nowadays called "business" and "financiering" is really swindling, if not stealing.

In this contest for control of the affairs of the road named, it has been shown by the testimony of the engineer in charge of the work, corroborated by the cashier and bookkeeper, that the actual cost of a terminal in Chicago was something less than $8,000,000, though in bonds and assumed indebtedness the cost to stockholders, and eventually, of course, to the public, was made $20,000,000, leaving $12,000,000 entirely unaccounted for.

As a result of this piece of "financiering" a number of "very prominent men," "substantial citizens," etc, have found it desirable, not to say highly important that they should leave the country; which they have done, with aliases instead of their proper names appearing upon the passenger lists of the steamers by which they sailed.

The whole thing is a disgrace not only to the rascals engaged in the transactions but to American railway management generally, and it cannot be denied that such accidental exposures (making it plain that there is much more not exposed to the light), do more than all other influences combined to produce dissatisfaction among the masses of the people; which is apt to be manifested in ill advised legislation or in worse ways.

What an encouraging thing it is, for instance, for a machinist working in a railroad shop or for the head of a department in such a shop to reflect that economies and improvements made by him as a result of a life's study and hard work, are a million times over swallowed up by a few weeks or days scheming of officers intrusted with management and control, assisted by lawyers to steer them clear of penitentiaries.

We do not for one moment think that an honest mechanic has the least reason to envy such precious rascals; quite the contrary, but this does not prevent his feeling dissatisfied with the relative rewards of honest, faithful service on the one hand, and of downright thieving on the other.

In all seriousness we declare our belief that such men as have been concerned in this Northern Pacific steal, and that are elsewhere carrying on similar operations, are infinitely more powerful factors in breeding discontent and disregard of law than all the sincere but misguided Coxeys that some of us have persuaded ourselves to believe dangerous to society.

Voting by Machinery.

All good citizens, whether machinists or not, ought to feel some interest in a machine which is coming into use for receiving and automatically recording votes.

The voter, after having established his right to vote in the usual way, or as prescribed by law, enters an apartment, and as he does so, faces a large keyboard, in which there are rows of keys resembling push buttons. Opposite each of these is the name of a candidate, and the candidates may be grouped together by parties with distinguishing colors.

When a key is pushed in, a vote for the corresponding candidate is recorded by the machine, and a registering or adding apparatus keeps count of all votes.

When a key is depressed, it remains so depressed, preventing a second vote by that key until the voter in the act of going out of the compartment and by the motion of the door, unlocks all keys, leaving the machine ready for the next voter. As soon as the polls close, the total vote, and the vote for each candidate can be read off from the machine, and the result of the voting announced within five minutes, leaving no chance for "doctoring" or false counting, and, in fact, preventing the performance of most of the tricks by which the will of the people is at present defeated in the interest of politicians and bosses.

The machine also insures, and even enforces, absolute secrecy in voting, thus dealing a heavy blow at vote-buying. It has been used in some of the towns of New York State, and we shall hope the time is near when many machinists and tool makers will be at work producing these safeguards to the franchise.

Great Northern Arbitration.

The fact that a committee of arbitration, composed of prominent business men and manufacturers of St. Paul and Minneapolis, made an award in the Great Northern strike, sustaining the position of the men and granting nineteen twentieths of their demands, must be taken to show that those demands were entirely reasonable and fair, especially in view of the fact that President Hill, of the Northern road, was, previous to the award, entirely satisfied with the personnel of the committee.

If the essential justice of the position of the men could have been recognized more promptly, or if arbitration could have been agreed to sooner a great deal of loss would have been avoided by both the men and the company, and what must now be a somewhat embarrassing position for some railroad and other journals which have been showing the utter unreasonableness of the men's demands, would also have been avoided.

In this matter of arbitration, we think, however, that Mr. Hill has made the best showing, since he had previously expressed a willingness to arbitrate, but the men refused.

We have previously expressed the opinion that the burden of proof in such disputes must lie with that side which refuses to submit to arbitration, no matter what the points at issue may be. The men, as we understand it, at first refused arbitration on the question of wages, claiming there was only one side to that question and that was their side. Granting the truth of this, they should have been all the more willing to arbitrate it, for the presumption is that arbitrators can see only one side of a question to which there is only one side.

Close of the Monthly Meetings of Mechanical Engineers.

The last of the first series of meetings of members of the American Society of Mechanical Engineers, of which we give an account elsewhere in this issue, showed even more clearly than the first one that there is, in New York at least, a demand for such meetings, that engineers will attend them and will discuss in an interesting way such subjects as are chosen with judgment and fairly presented.

Mr. Forney (to whose efforts more than those of any one else the success of the meetings is due) in discussing the question of the advisability or method of conducting such meetings in the future, said that the matter of their continuance in some form would come up for discussion at the forthcoming meeting of the A. S. M. E., at Montreal. If at that meeting it is decided to take up the matter and hold such meetings in future under the auspices of the society, there will be, of course, considerable additional work for some one within the society—possibly more than has been involved in the series of meetings just closed, though that has been by no means inconsiderable. If the matter be not taken up by the society there may be some little difficulty in getting a committee so efficient, so willing to work, and even to contribute funds as has been the case with the committee whose labors have just ended.

The cable reports of the opening ceremonies of the Antwerp World's Fair show that that exhibition is certainly not proportionately nearer completeness than the Chicago Fair was on its opening day. Of course, there is not so much yet remaining to be done, but in proportion to the total amount of work connected with the respective enterprises, the Chicago administration makes a very favorable showing indeed.

In point of magnitude and importance of the various countries represented ours is classed as sixth, Belgium, France, Germany, Great Britain and India surpassing us in the order named.

Literary Notes.

LOCOMOTIVE MECHANISM AND ENGINEERING. By H. C. Reagen, Jr. First Edition.

This book has evidently been written by a practical man of considerable experience, and one who knows how to convey his knowledge to others. The subjects are presented in such a manner as to be attractive, interesting and instructive to all who are trying to increase their knowledge of the steam power under their control, decrease the chance of accident, increase the safety of human lives, and give greater satisfaction to their employers. Many of the chapters open with an explanation of the construction and action of some particular details of the engine, and conclude with questions and answers relating to the same. This arrangement we believe to be very advantageous to the reader whose desire is to obtain a thorough knowledge of the subjects he has studied, as it will test his knowledge obtained by previous reading; it may compel a review of the subjects, and thus impress many important points more vividly on his mind, and thereby enable him at some future time to answer questions asked for the purpose of testing his fitness for promotion.

Some of the principal breakdowns that may happen to a locomotive are illustrated, and the modes of procedure under the circumstances are explained. Valve motion; valve setting; descriptions of various systems of compound locomotives, the object of their use, and the principle upon which they work; injectors, safety valves, steam gauges, brakes, air pumps, pump governors, and Westinghouse brakes, are among the important subjects treated. The book contains 287 pages of reading matter, the various subjects are well illustrated, and the index is very complete, so that the book can be used as a book of reference. A careful perusal of its pages by locomotive engineers and firemen will be of great assistance to them in seeking an advancement in their vocation. It is published by John Wiley & Sons, 53 East Tenth street, New York. Price $2.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(232) W. T. S., Milwaukee, Wis., writes: Kindly direct me to a recent number of your paper containing an article treating on the theory of the planimeters. *A.*—January 28, 1892. We have not published anything on the particular kind of planimeter to which you refer.

(233) J. K. C., ——, Canada, writes: Please send us, or inform us, where we can obtain a book treating on setting and sharpening saws? *A.*—The book treating on saws, by R. Grimshaw, may suit you. It is published by E. Claxton & Co., 930 Market street, Philadelphia, Pa. We do not deal in books.

(234) G. G. S., Pawtucket, R. I., writes: Please inform me how a vacuum is obtained in a compound engine? *A.*—A vacuum is formed in a low-pressure cylinder only. It is obtained in the same way as in any simple engine, namely, exhausting the steam into a condenser, and then abstract the vapor and water of condensation from the condenser by means of an air pump.

(235) W. G. S., Montville, N. J., writes: Please give me the name of a good and simple book treating on electric-light plants,

and the localization and remedy of troubles in dynamos, and management and running of dynamos. *A.*—"The Practical Management of Dynamos and Motors," by F. B. Crocker, and S S. Wheeler, published by D. Van Nostrand Company, 23 Murray street, New York, will probably give you the information you seek.

(236) L. E. B, Cortland, N. Y., asks: Will a gas engine make an explosion at every revolution if the load requires it? *A.*—There is a class of gas engine which will do so; in fact, the two most prominent systems which have been developed are, one in which the charge is fired with every revolution, when the cylinder is about half full of air and gas; the other at each alternate revolution, when the piston is near its remote dead point. 2 Does an oil engine work on the same principle? *A.*—There is a class of oil engines which do the work on the same principle, others do not.

(237) A. K., Chicago, Ill., writes: Please answer the following through your columns: Where can the book entitled "Steam Saw Mills," by M. P. Bale, be obtained? Also give price and publishers' name? *A.*—The book can be obtained from its publishers, Lockwood, Crosby & Sons, New York; price, $4. 2. Please give titles of other books and names of publishers, treating on saw-mill engineering? *A.*—"The Art of Saw Filing," with explicit directions for putting in order all kinds of saws, from a jeweler's saw to a steam saw mill, by H. W. Holly, published by John Wiley & Sons, 53 East Tenth street, New York.

(238) G. H. G., Central Falls, Vt., writes: Please inform me if a vacuum is given in inches or in pounds. If it is given in inches please give the reason for doing so. *A.*—In steam engineering it is generally given in inches. The reason for this is that before the Bourdon gauge came into use the vacuum gauges were like a barometer, in which a column of 30 inches of mercury balances the atmospheric pressure. To avoid confusion the new gauges were marked in the same way. In steam engineering the expression, a vacuum of 25 inches, simply means that the exhaust steam will balance $30 - 25 = 5$ inches of mercury, the corresponding pressure in pounds will be

$$14.7 \times \frac{5}{30} = 2.45 \text{ pounds per square inch.}$$

(239) C. W., Dayton, O., asks: What objection is there to making the piston of a steam engine indicator ¼ of a square inch in area? *A.*—There is no objection to making the piston ¼ of a square inch in area for indicators used for high steam pressures, in fact, pistons of this size are sometimes furnished with indicators having the standard size of piston, ½ square inch in area. This change of piston doubles the capacity of each spring, thereby adapting the indicator, which, with the standard size of piston, will indicate up to 250 pounds only, to indicate pressures up to 500 pounds. 2. Have any actual tests been made with the cheaper grade of indicators? *A.*—Yes; the price is not always an indication of quality.

(240) H. R. J., Arkansas City, Kan., writes: I want to galvanize sheet steel and also rounds and flats. Can you tell me what an outfit would cost to galvanize sheets as large as 2 by 6 feet? Or, can you refer me to some good writings on the subject? *A.*—We are more interested in the arrangement of plants and construction of machinery than in their cost, and therefore cannot give you the best advice in the matter. However, to lay out a plant in which the handling of work and production is reduced to a minimum, and the first cost of the plant kept as low as possible will involve considerable time and labor, and experience, and we should strongly advise not to attempt to arrange the plant yourself without the assistance of a first-class mechanical engineer or some one thoroughly familiar with this class of work. We do not know of any book that will give you the desired information.

(241) C. W. G., Reading, Pa., writes: Please give me the ingredients of a bright black Japan varnish? *A.*—The varnish consists essentially of pure natural asphaltum with a proportion of gum animé dissolved in linseed oil and thinned with turpentine; but there are numerous receipts given for the varnish, and manufacturers generally conceal the composition of their own preparation. One of the receipts is as follows: Melt together 50 pounds of Naples asphaltum and 8 pounds dark gum animé, and boil for 2 hours in 12 gallons of linseed oil; then melt 10 pounds of dark gum amber, and boil with two gallons of linseed oil; add this to the other, with a sufficient quantity of dryers, and boil for 2 hours longer, or until a little of the mass, when cooled, may be rolled into pills; then withdraw the heat, and afterwards thin down with 30 gallons oil of turpentine. This is said to be a good black Japan varnish for either wood or metals.

(242) C. G., Detroit, Mich., writes: I wish to know what the mean pressure of air will be when cut off at half stroke in the cylinder, the initial pressure being 15 pounds per square inch. *A.*—We assume that the given pressure is that above atmospheric pressure. Under these conditions, the mean absolute pressure for the whole stroke will be 25.1 pounds, or 10.4 pounds above the atmospheric pressure. 2. Will the pressure at the end of the stroke be nothing? *A.*—The pressure at the end of the stroke can never be equal to zero; under the above conditions the absolute pressure at the end of the stroke will be 14 85 pounds, or .15 pound above the atmospheric pressure. Your third question cannot be answered for the reason that pressure at the end of stroke can never be zero. 4. Would there have been any difference in the mean pressure if steam had been used in place of air? *A.*—Theoretically, yes; but the difference is so small that for all practical purposes it can be neglected.

(243) W. H., Washington, D. C., writes: I am building a chime whistle and would like to know if the partitions in the bell are placed at equal distances apart, or should there be a difference made in the height of the openings at the bottom of the bell? *A.*—There is generally no difference made in the height of the openings The partitions are placed at equal distances apart; the difference in sound is produced by making a difference in the height of the compartments in the bell. 2. Will a chime whistle work with a pressure of 75 pounds in the boiler? *A.*—Yes, provided the bell is set at a correct distance above the bowl. A chime whistle made to blow at low pressure, will become shrill and discordant under high pressure. By a movable bell it can be set at a point to produce a clear and full tone under any pressure. 3. Will brass $\frac{3}{64}$ of an inch be thick enough for a bell 12 inches by 6 inches? *A.*—Yes. These whistles are patented, and unless you have permission to make them, you are liable to get into trouble.

(244) D. E. C., Brandon, Canada, asks: About what power will a small engine 2 by 3 inches develop, steam pressure being 100 pounds, revolutions 250 per minute? This engine is to be used for a small boat. *A.*—About ½ horse power. The speed of this engine is too slow for the purpose, we should run the speed up to 450 revolutions per minute, and thus obtain about ¾ horse-power. 2. What power will I gain by adopting a double engine in place of a single one? *A.*—That will depend on the size of cylinders, if the size is not changed, the double engine will develop twice as much power as the single one. The advantage of the double engine is that the cranks can be set so that the engine will not stall on a dead center. 3. What size shell of boiler will be required for this engine? *A.*—For ½ horse power, shell 19 inches diameter and 24½ inches high; furnace, 13¾ inches diameter and 14 inches high; flue, 4½ inches diameter. For ¾ horse-power, shell 23¼ inches diameter, 31 inches high; furnace, 18 inches diameter, 18 inches high; flue, 6 inches diameter.

(245) X. Y., Springfield, O., writes: Have you published a book pertaining to link motion? Or, can you recommend a firm which does publish the same? *A.*—We do not publish any books. The construction of the link motion considered from a practical standpoint, has been published in our columns in the series of articles on Modern Locomotive Construction. The rules given in these articles are applicable to all links of the same class for stationary and marine engines. We can furnish a few full sets of these articles only, we cannot furnish separate numbers published prior to 1893. "Practical Application of the Slide Valve and Link Motion," by W. S. Auchincloss, C E., published by D. Van Nostrand Co., Murray street, New York, is considered to be a standard work treating on this subject. "Valve Gears for Steam Engines," by C. H. Peabody; and "Valve Gears," by H. W. Spangler, P. A. Engineer U. S. Navy, are also good books, both are published by John Wiley & Sons, 53 East Tenth street, New York.

(246) R L. C., Muncie, Ind., writes: A piston is to be moved upwards in a given cylinder *A* by pressure, and fall by gravity. This cylinder is connected by pipes to another cylinder *B* or reservoir a little larger than *A*. The cylinder *B* is filled with water or nearly so. When steam is turned on so as to allow it to act on the top of the water in *B*, the water will be forced into the cylinder *A* underneath the piston, raise the latter and practically empty the reservoir *B* of water. If now the supply of steam into *B* is stopped, how long will the steam pressure in *B* keep the water in *A*? Will the condensation of steam in *B* be so great as to allow the piston in *A* to fall and not hold the piston and load it carries at any one point for any considerable length of time? *A.*—The steam will, of course, condense when in contact with the water, but the time of condensation, and consequently the time of descent of the piston in *A* will principally depend on the area of the surface of the water exposed to the action of the steam, the volume of the water and its temperature and the original pressure of the steam. After condensation the volume of the water will be increased, air will also be admitted into *B* with the steam so that there will always be some vapor above the water in *B* exerting a resistance against the descent of the piston. The temperature of the water may also increase after each stroke of the piston, so that on the whole it will be a difficult matter to determine the results without resource to experiments.

(247) O. C., Oakwood, N. Y., sends us two sketches of a shaft governor designated Nos. 1 and 2, and asks which of the two designs we prefer. *A.*—We prefer No. 1. The other design will not be as sensitive as No. 1, because in No. 2 the point of suspension of the weight, the center of gravity of the weight and the center of the shaft are in one straight line. 2. When computing the centrifugal force must the weight of the lever to which the weight is attached be taken into account? *A.*—Yes. 3. What will be the pull on the spring? *A.*—You have not given sufficient data to compute it. The length of the lever to which the spring is attached is not given, neither have you given the exact relative positions of the point of suspension, the center of gravity of the weight, and the center of the shaft. 4 For computing the centrifugal force would you use Molesworth's formula, is it trustworthy? It seems to differ widely from other formulas. *A.*—The formula given by Molesworth is correct. It does not differ from other correct formulas, although at first glance it may appear to do so. The general formula for computing the centrifugal force is

$$f = \frac{W \times v^2}{g \times r}, \qquad (1)$$

in which f = centritugal force, W = weight of body, v = velocity in feet per second, r = radius to center of motion in feet, and g = acceleration in feet per second due to the force of gravity which may be taken at 32.2. If now the velocity r is given in feet per minute then formula (1) becomes

$$f = \frac{W \times r^2}{32.2 \times r \times 60 \times 60}. \qquad (2)$$

The velocity in feet per minute is

$$v = (2\ r \times 3.1416 \times n),$$

in which n = number of revolutions per minute. Substituting this value for v = formula (2) we have

$$f = \frac{W \times (2\ r \times 3.1416 \times n)^2}{32.2 \times r \times 60 \times 60},$$

which reduces to

$$f = .00034 \times W \times r \times n^2$$

and agrees with the formula given by Molesworth.

(248) G. B, Lapeer, Mich, writes: Please answer the following questions through your columns: "A." says that an engine with the center of the shaft 2 inches above the center line of cylinder has its dead centers on the crank circle directly opposite, and on a diameter drawn parallel with the center line of cylinder, and that these centers are found by tramming. 'B." says that the dead centers on this engine found by tramming are not directly opposite on the crank circle, and that the center of the crank pin, center of shaft, and center of crosshead pin must be on one line when the engine is on a dead center. *A.*—"B." is right. The positions of the crank-pin when engine is on a dead center are easily found on a drawing board as follows: From the center of the shaft describe an arc whose radius is equal to the length of the connecting rod minus the length of crank; the point in which this arc intersects the center line of cylinder produced is the position of the center of crosshead pin when the engine is on one of its dead centers. Through this point and the center of the crank shaft draw a straight line, and produce it so as to intersect the crank pin circle; this point of intersection will be the position of the center of crank-pin when the engine is on a dead center. For the position of the pin on the opposite dead center, describe from the center of the shaft an arc whose radius is equal to the length of the connecting rod plus the length of the crank; the point in which this arc intersects the center line of cylinder produced will be the position of the center of the crosshead pin on its dead center. Through this point and the center of the shaft draw a straight line, and the point in which this line intersects the crank-pin circle will be the dead center of the crank pin. With the positions of the crank pin centers established in this manner, it will be impossible to draw a diameter of the crank-pin circle through the center of the shaft and the two positions of the center of crank-pin. 2. What will be the effect on the valve motion of a common slide valve engine by placing the crank-shaft out of line with the center line of cylinder? *A.*—It will interfere with the symmetrical movement of the valve, but this will be so slight when the shaft is moved a short distance only out of line with cylinder that it may be neglected. The stroke of the piston will also be slightly greater than the diameter of the crank-pin circle.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Speed Gage McLauthlin & Co., Fulton St., Boston.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O.

Engine Castings, 1 to 6 Horse-power Vertical. Humphrey's Foundry, Bellefontaine, O.

American Packing Rings make pistons steam tight. Are simple, durable and inexpensive; write for circular. J. H. Dunbar, Youngstown, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

"The Fireman's Guide;" post free, 50 cents. Lists free. Spon & Chamberlain, 12 Cortlandt street, New York.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co., New York, N Y.; Cincinnati, O., & Stroudsburg, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO, 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid Published by John Wiley & Sons, 53 East Tenth street, New York.

Water-tube Boilers.

The final meeting (of the series) of members of the A. S. M E, was held the evening of the 9th, at the society's house as previously announced. The attendance was good and the interest which has been taken in the meetings, from the first, was well sustained to the end.

In the absence of Mr. Walter M. McFarland, U. S. N., of Washington, who had been invited to open the discussion on "The Use of Water-tube Boilers in the Navy," Prof. F. R. Hutton read the paper forwarded by Mr. McFarland, given below:

Having been honored by the committee which is in charge of these monthly meetings of the society with an invitation to prepare a few remarks to serve as a basis for a discussion of the subject of water-tube boilers, with special reference to their use in the Navy, I have pleasure in complying; but must state at the outset that the request came at a time when pressure of other matters did not give me the leisure necessary to go into the subject as carefully as I might have wished.

In this matter of water-tube boilers I shall confine myself to the type known as tubulous or coil boilers, merely mentioning that years ago a water-tube boiler, invented by Engineer-in-Chief Martin, of the Navy, was in use for some years and gave satisfaction. This, however, was a shell boiler, and its weight was about the same as that of fire tubular boilers, so that it does not come properly in the category we propose to discuss.

It may be stated at the outset that coil boilers possess certain advantages which recommend them for use in naval vessels, and would make their adoption a certainty but for one or two features. From their successful use naval designers have had their ultimate adoption in mind and have watched the development with the greatest interest. In our own Navy extended experiments were made by boards of naval engineers,

under the direction of that great engineer, Isherwood, on the Herreshoff boiler, so that full information was possessed in this respect. Experience with them, however, was not such as to warrant their adoption for use in large vessels.

The advantages offered by coil boilers for naval vessels may be stated as follows:

Reduction of weight of boiler and contained water.

Adaptation to very high pressures.

Safety against disastrous explosion.

Rapidity of raising steam.

Freedom from injury due to forced combustion.

Facility in renewal when worn out.

Against these advantages is to be set:

Greater injury by corrosion.

More care required in feeding.

As a matter of fact, if it were not for the trouble due to corrosion, there would be hardly anything to be said against the coil boiler, for the difficulty sometimes due to feeding is a matter of training of the attendants. A friend recently wrote me in regard to the boilers of the "Monterey," where each fire-room has two Ward boilers and one cylindrical: "One feed-pump can be made to supply both Ward and Scotch boiler in battery, but every chump who calls himself a water tender can't do it."

It is hardly necessary to elaborate the advantages, but it may be remarked that the reduction of weight is the greatest. For the last 10 years the demand on the designer of naval machinery for increased power on reduced weight has been growing stronger, and although forced draught does materially reduce the boiler weight, it has not been an unmixed blessing. When we reflect that coil boilers weigh less than half as much as cylindrical ones for the same power, and that they can be forced to any extent without danger of injury, we see how desirable the coil boiler becomes.

As in the case with many other improvements in steam machinery, the Navy has followed rather than led outside practice. The reason for this is not hard to understand when we reflect that the officers charged with the carrying out of government work have not the free hand of those in civil life. A designing engineer frequently has unusual opportunities given him by the fact that some yacht owner demands exceptional speed, and is willing to sacrifice almost everything to attain it. Such a case would offer a splendid opening for the trial of a tubulous boiler.

In 1885, the late Admiral Simpson, of the Navy, who had been president of the Naval Advisory Board, in an inaugural address as president of the Naval Institute, made the remark that the great necessity for improvement in naval vessels was in reduction of weight of machinery, and that he thought it lay in the direction of using Herreshoff boilers rather than those of the ordinary shell type. He doubtless selected the Herreshoff boiler for the reason that some launches with this boiler had been used in the Navy, and it was the only one with which he was familiar. In that society it was not considered the proper thing to discuss or criticise the inaugural address of the president, so that no reply was made to the remark at the time, as could very readily have been done; but at an adjourned meeting which I attended, Passed Assistant Engineer Kafer, then attached to the Bureau of Steam Engineering, did discuss the subject in an informal way, and he remarked that the Engineer in-Chief of the Navy, who was then Mr. Charles H. Loring, who has since been president of our society, was fully alive to the promise of tubulous boilers, but that he was not willing to stake his professional reputation on their success by powering a vessel of any size with them. He was perfectly willing, Mr. Kafer said, to advocate their adoption experimentally on a small vessel, but it must be understood that it was an experiment; and he called attention to the fact that it was a very easy matter for people who had no responsibility attending their recommendations to advise certain lines of action, while the ones on whom the responsibility came were necessarily compelled to be more conservative.

Not very long after this a test of a Ward launch boiler was made by a board of naval engineers, Mr. Ward having offered his boiler for test and agreed to defray the expenses, and this test showed excellent results, both as regards economy of evaporation and power for a given weight. Herreshoff boilers had been used, as I have already said, in naval launches for some time, but they were not entirely satisfactory in every respect and had not been generally adopted. The test of the Ward boiler gave information of a type of boiler adapted to all the requirements of naval purposes, and in 1888 several of them were fitted to naval launches. Their success was very marked, and since that time no new boats have been built which have not been fitted with coil boilers, although other types besides the Ward have been used, a number of Towne boilers having been fitted, and also one or more, each, by Roberts and Almy. Our experience with the Ward boiler has been more extended than with any of the others, and I have heard a number of officers who have had experience with it in different portions of the globe testify uniformly to their entire satisfaction with it.

About 1888 the Navy Department made a contract with the Herreshoffs to build the "Cushing," and the design in every respect was left to them. At first it was the intention to use Herreshoff boilers, but subsequently that firm, having acquired the control of the Thorneycroft patents for this country, requested and obtained permission to use Thorneycroft boilers in the "Cushing." In the early part of 1890 the "Cushing" was tested officially, after having been given a number of private tests by the builders. The official test as well as the others were very satisfactory, and showed the boilers to fulfill the requirements of the case with great satisfaction. In the *Journal of the American Society of Naval Engineers* for 1892, Chief Engineer Isherwood has written an article about the "Cushing," which gives an extended account of the boat and all her various trials.

In the fall of 1890 a series of tests of one of the boilers of the "Cushing" was conducted by a board of naval engineers under the presidency of Chief Engineer Loring, and a large amount of valuable information obtained. A copy of the report of this board was published in the report of the Bureau of Steam Engineering for 1891.

In 1888 Engineer-in-Chief Melville of the Navy urged upon the Secretary the importance of experiments on a large scale, to determine the suitability of tubulous boilers for use as a part or all of the boiler power of our naval vessels, and in accordance with his recommendation the Secretary sent out an invitation to all the builders of coil boilers in this country, inviting them to submit plans and prices to meet specifications which had been prepared by the department. Some 15 or 20 replies were received, and in 1889 an invitation was sent to the makers of those boilers which appeared adapted, asking them to suggest a time when they would be ready to have their boilers tried. Four of the firms, who had previously replied, acknowledged the receipt of this letter, but only two of them actually submitted boilers for trial, Mr. William Cowles and Mr. Charles Ward. A boiler made by each of these gentlemen was tested by a board of naval engineers, under the presidency of Chief Engineer Loring, and the report giving the results was published in the report of the Bureau of Steam Engineering for 1890.

As a result of this competitive test the boiler submitted by Mr. Ward was adjudged to have given the best performance, and in accordance with the terms of the proposition under which the tests were made, a contract was concluded with him for supplying boilers for the U. S. S. "Monterey," to furnish the steam for 4,200 horse-power in triple-expansion engines. The trial of the "Monterey" took place in 1892, and the boilers gave a very good account of themselves, the engineer officers who attended the trial speaking in the highest terms of their creditable performance. The trial of the "Monterey" was not in every respect a complete success, because the horse power of the machinery fell slightly below that required by the contract, and in explanations as to the cause of this deficiency, there was some difference of opinion. There was no means of telling certainly how much steam was supplied by each kind of boiler (there being two single-ended cylindrical fire tubular boilers besides the four Ward boilers). The naval engineers who were present attributed the failure to attain the horse-power to lack of skill on the part of the firemen, while I have understood that engineers connected with the Union Iron Works, who built the vessel, and all the machinery except the Ward boilers, thought that the trouble was partly due to the coil boilers. They thought this was not due to any defect in the boilers themselves, but to the fact that their position in the ship was such that it was difficult to clean the fires, and keep them in the best possible condition, and that on this account there was a falling off.

It is to be noted in connection with this trial that a very high air pressure was used at times, as much as four inches of water, and although some leaky tubes were developed in the cylindrical boilers, the coil boilers showed no signs of injury in any respect, and after the trial were as tight as before.

This comprises the actual experience in use in our own Navy up to date. The "Ericsson," a sister torpedo boat to the "Cushing" with a few changes, now building at the Iowa Iron Works, is to have Thorneycroft boilers, while four third-class torpedo boats for the "Maine" and the "Texas" are to have Mosher boilers.

In a design elaborated at the Bureau of Steam Engineering last year, coil boilers in connection with cylindrical are to be used in supplying a quadruple expansion engine. The coil boilers will furnish steam at 250 pounds to the high-pressure cylinder, while the cylindrical boilers will supply steam of about 150 to 160 pounds to the first receiver. The type of coil boilers to be used has not yet been settled, as it is the policy of the Department to permit the contractors to make the selection in the first instance subject to approval.

Last summer at the International Engineering Congress a paper was read on the subject of coil boilers in general by Mr. Ward, and in the discussion of that paper I remarked that it appeared to me that the most important question in connection with coil boilers was their longevity. Being composed entirely of tubes of small diameter and quite thin, it naturally follows that corrosion will be a very important factor in their usefulness. Mr. Ward has informed me personally that some of his boilers which have been used on Western rivers, and have never been exposed to the influence of salt water in any way, have already been in service for over 10 years and are still in excellent condition. There are also some in use on yachts, I believe, which have had six or seven years' service, and the revenue cutter "Manhattan" has a boiler which was put in in 1888, I believe, and is still in good condition. The launch boilers that we have used in the Navy have been satisfactory in respect to longevity, as none of them have as yet given out, except in an occasional tube here and there, which were easily repaired. The "Monterey," of course, has been too short a time in service to have any question of longevity raised. The boilers of the "Cushing" have now been built at least five years, and they are in excellent condition, and have shown no signs of pitting or other serious deterioration.

The question of corrosion assumes a somewhat different phase for coil boilers from the same phenomenon for shell boilers, because in the latter the tubes form a relatively secondary part of the boiler, while in the former they practically are the boiler; and, as has been repeatedly pointed out, a leaky tube in a shell boiler can be plugged while steam is up; but this cannot be done in the coil boiler. There is no reason why the tubes of a coil boiler should deteriorate any more rapidly than those of a shell boiler, and in many types they ought to last longer because thicker.

Mr. Ward has stated that one of his boilers built nearly 14 years ago has lost only one tube, while a number of other boilers have been in use for six or seven years and given no trouble. Mr. Roberts also states that the first of his boilers built about 15 years ago has never given any trouble from corrosion. It is probable, however, that most or all of these boilers have been carefully kept free from the deleterious action of salt water, although a good many of these boilers are fitted in yachts about New York.

I might, then, sum up our experience with coil boilers by saying that as regards lightness, rapidity of raising steam, safety against disastrous explosion and safety against injury by excessive forcing, they have given entire satisfaction.

The experiments on the Ward and Cowles boilers in competition, and those on the Thorneycroft boilers of the "Cushing," and the Ward boilers on the "Monterey," show conclusively that coil boilers will stand any amount of forcing without injury, as these were all subjected to air pressures of 2 inches and over for long periods without a single leak being developed. We also made a severe test of a small Towne boiler at one of our navy yards by running it for several hours under forced draught, then hauling fires as quickly as possible, and turning a stream of cold water on every part of the boiler from a hose, so as to get the full effect of sudden contraction. Not a leak developed anywhere.

With regard to longevity, it is as yet too early to speak, but such experience as we have had leads us to believe that with proper care to guard against corrosion they should have a reasonable life.

In this connection it is worth noting that the Belleville boiler has been in use in the French Navy for at least 10 years, and the experience with it has apparently been so satisfactory as to lead the English Government to place an order for a set of these boilers for the large English cruisers "Powerful" and "Terrible," which are to have about 30,000 horse-power each. The Belleville boiler differs very materially from the coil boilers invented in this country, and all others invented abroad, in having its tubes of very large diameter, and much thicker than those in any other coil boiler. The tubes are generally about 4 inches in diameter, and the lower row are about three-eighths of an inch thick, and no tubes are less than .20 of an inch. This undoubtedly accounts for the long life of these boilers, as it is manifest that a trifling bit of corrosion which would go clear through a thin tube will only affect these thick ones half as much, and will still leave them serviceable for a long time. The great trouble with the Belleville boiler, compared with most other coil boilers, is its weight. We shall doubtless shortly have some valuable data in regard to this particular boiler from the experience with the fast express steamers on the great lakes, which are to be fitted with boilers of this type.

The number of coil boilers is almost legion, and every inventor brings out some change in his own type at frequent intervals. I presume it would be safe to say that nearly all that are designed with any regard to a good circulation will give good results, and such has certainly been our experience with those thus far used in our Navy. It is curious to observe, however, how ideas change in regard to what is necessary to secure a good circulation. Mr. Ward has always claimed that you could put your down current almost anywhere if the feed went into it, and that, of necessity, if the water went up in some tubes it must come down in others. For a while Thorneycroft, Mosher, and some others provided down cast pipes entirely outside the boiler, but they have now abandoned that plan.

I feel that I must apologize for the in-

completeness of this paper, but I would refer those who desire an elaborate investigation of the subject to the paper by Mr. Ward, read before the International Engineering Congress, and published in the *Proceedings of the Division of Marine and Naval Engineering and Naval Architecture*, and to papers read last year and this before the Institute of Naval Architects in England, by Mr. J. T. Milton, chief engineer surveyor to Lloyd's. The subject is a thoroughly live one, and I am glad the society has taken it up. A number of our members have much greater personal knowledge of the characteristics of particular types of these boilers than the writer, and it is to be hoped that during the discussion on this subject they will give the society the benefit.

At the close of the paper Mr. C. E. Emery gave some of his experience with the earlier forms of tubular and coil boilers, after which Mr. Jas. T. Boyd related some experience with the Belleville boiler, his conclusion being that this form of boiler was very satisfactory as regards keeping clean and was also light for its power when steam was carried in it at considerably higher pressure than used in the engines, as was the intention in this design of boiler.

Mr. H. De B. Parsons detailed some of his experience with Herreshoff boilers sustaining his conclusion that:

The result of my experience from these cases and others is this: If you are going to use a water-tube type of boiler you have got to have plenty of grate surface. They need more grate surface than the other type. I know they will stand forcing according to the tests, but my experience does not indicate that they will give in ordinary practice the horse-power per square foot of grate that you can get out of the old fashioned boiler. The reason of that is probably that there is no storage of steam, no steam space, and no energy stored in hot water, and the consequence is when the steam once gets down you cannot build it up very well; the engine will take it faster than it makes, unless you have boilers of ample size.

My first effort in engine designing was an absolute failure. It was an effort like what most young men make in attempting to design something which they know very little about. I undertook to design a coil boiler. My ignorance led me to use tubes of different sizes. Result: the small tubes evaporated faster than the larger ones, and the consequence was that there was some sort of circulation—I don't know what. But the boiler acted very strangely. There was absolutely no water to be found anywhere near it. There was steam in it, but where the steam came from I do not know. Mr. John C. Kafer, said: . . . The design of water-tube boilers has been to make steam on very little weight. If we were satisfied to make as we were thirty or forty years ago, there would not be any water tubes in existence. But the problem now is to get maximum power from minimum weight, and that is the problem for the water-tube boiler. If you have a water-tube boiler with sufficient grate surface, that alone will not accomplish the result. You must burn coal at a maximum rate of combustion, and if you burn 50 pounds per square foot of grate surface in a Scotch boiler, you certainly have a very much heavier boiler than if you burn 110 pounds per square foot of grate in a tubular boiler. If a designer were to select any particular type of water-tube boiler, he will probably meet with bad results in one way or another. You must take whatever you have and make the best of it. The great difficulty in the water-tube boiler is to get it perfectly accessible. With tubes readily removable repairs can be easily made, and it should be made to last a reasonable length of time—not to last the length of time that a Scotch boiler will last. I do not know of any one boiler in the market that will fulfill all the conditions and yet have maximum power for minimum weight. The great difficulty with designers has been to crowd too many small tubes in the space allotted to them, and for that reason they want to get rid of the weight of water. That is the chief advantage of the water-tube boiler having small tubes. The Belleville boiler has been spoken of by Mr. Boyd. It is a very excellent boiler to operate under natural draught. But if you will take a box coil and have a hot fire under the lower coil and burn 50 pounds of coal per square foot of grate, you will find trouble before you get up to the upper end. That is one reason why a Belleville boiler will weigh more than a Scotch boiler, or nearly as much as a Scotch boiler of the same relative horse-power under forced draught. The Belleville boiler must be operated at a lower rate of combustion than that at which the Scotch boiler can operate with perfect safety.

With reference to the other types of boilers—Yarrow and Thorneycroft and others, they all depend on the natural circulation due to the less weight of water. It is well known, I think, that a boiler of that type will hardly evaporate as much water per pound of coal under ordinary conditions as the ordinary Scotch boiler. But if you could have an engine on the outside and force the water through the tubes, so that you knew when the shaft was turning that the water was going through the tubes, you would accomplish perfect circulation, and yet you might have the tubes in such a position as not to have corrosion when the vessel was laid up.

(*To be continued.*)

The New Steamer "Priscilla."

The trial trip (made on the 9th inst.) of the new steel steamer "Priscilla," for the Fall River Line, Old Colony Steamboat Co., was a very successful one. It was the first trip the boat has made, and its purpose was not to determine the speed of the boat, but to test the working of the machinery which was very satisfactory in every respect, and the builders were certainly entitled to the many compliments received from the prominent engineers on board. The ease with which the engines were handled, the promptness of response to the signals from the pilot house, steady motion, and the maneuvering power of the boat were admirable.

The main engine, as we have stated in our issue of the 3d inst., is of the double inclined compound surface condensing type, of 8,500 maximum horse-power. The two high-pressure cylinders, each 51 inches diameter, are placed side by side, forward of the main shaft, and the two low-pressure cylinders, each 95 inches diameter, are placed side by side, aft of the main shaft; all have a stroke of 11 feet.

The main engine shaft is in three sections, the two outboard ones having the driving, and the center section the drag cranks, there being two sets of cranks set at right angles. Each crank-pin is connected to the connecting rods of a high and a low-pressure cylinder. Owing to the inclination of the cylinders, the connections of but one cylinder can be thrown upon a dead center at the same time, thus insuring a very steady and even rotation of the main shafts, an equal distribution of power and minimum vibration. Each low-pressure cylinder has its own air pump and surface condenser. The air pumps are vertical and are worked from the low-pressure crossheads. There are two independent centrifugal circulating pumps for each condenser. Total cooling surface of condensers, 16,000 square feet. The main steam chest valves are of the double poppet type, and are worked by double eccentrics and links. High-pressure cylinders have adjustable drop cut-offs; low-pressure cylinders fixed "Stevens'" cut-offs.

The boilers, whose dimensions are given in our issue of the 3d inst., were built for a maximum steam pressure of 150 pounds. This is far in excess of what will be required for the usual business of the steamer, but is advantageous in permitting a large range of pressure. The boilers are fitted both for natural and forced draft under grates. The forced draft is supplied by two large "Sturtevant" fans driven by independent engines. These steam fans being placed in the main engine department serve also to ventilate the engine room. The total grate surface of boilers is 850 square feet. Total heating surface 35,400 square feet.

An extra large donkey boiler and two large fire and wrecking pumps are on the main deck. The pumps are so arranged and connected that they may for all purposes work independently or together. There is also a large bilge pump in the engine department below deck, forming in all three complete wrecking and four very complete fire systems extending the full length and throughout the vessel. In addition, there are a number of hand pumps in various parts of vessel.

There are five decks—main, saloon, gallery, break and dome, on which are located 361 staterooms (including 14 parlor rooms) for passengers, and 35 officers' rooms, making a total of 396 staterooms. In the cabin for the men and women are 219 berths. For the second-class passengers, 89 berths are provided, and 155 berths for the crew.

We believe it is safe to say that this steamer is one of the most handsome, thoroughly equipped and commodious passenger steamers afloat. The style of decoration throughout the greater part of the steamer is that of pure Italian Renaissance, giving a beautiful and harmonious effect.

The quarter deck is very spacious, with a floor laid in marble mosaics. From the quarter-deck, the grand staircase leads to the main saloon. It is made of solid mahogany, with the strings of railing of wrought-iron. Here, also, are the ticket-office, barber shop, coat room, and the entrance to the dining-room lobby. The walls of the quarter deck are finished with mahogany, and ornaments and panels of papier maché, representing by groups of figures in low relief, commerce, arts and sciences, music and the dance. The dining-room lobby is finished in mahogany and papier maché panels, and is decorated in cream, white and gold. On the port side of lobby a large staircase leads to main saloon above. On starboard side of lobby a staircase leads to men's saloon in hold. From the lobby you enter the dining-room, which is one of the greatest features of the steamer, and its size, grandeur, and rich effect are at once evident. The style of decoration is purely "Indian," mahogany finished, and in all details the designs have been faithfully executed. On each side of the room are six large windows; between the windows are beautiful mahogany sideboards, with large glass mirrors. In the lower part of the side boards, fire-places have been built, and they contain the radiators concealed by brass shields, forming a clever arrangement of heating the room. At the forward end of dining room are the cashiers' desks, silver locker, coffee urns, and staircase to kitchen and pantry below the deck. Both forward and after bulkheads have large mirrors, producing in effect a much larger room, and a succession of mirrors and columns, and a display of Oriental magnificence.

The lighting of this room is obtained through panels of delicate colored leaded glass, covering the upper part of the recess formed by the sideboards. These panels are directly over the windows. The recess contains groups of electric lights and extensive reflectors. From the rich and handsomely paneled ceiling, light is also obtained through leaded glass globes, all conforming and harmonizing with the general design of room, and producing a rich and dignified effect.

From the after end of dining-rooms are entrances to two private dining-rooms, also in Indian style, treated in color, one of them in white and gold.

The principal features of the grand main saloon are its size, its richly decorated ceiling and forward bulkhead in relief of papier maché, the system of lighting from the dome, the beautiful electric features, the large and spacious staircase of mahogany leading to the gallery, with its strings of railing of handsomely wrought-iron.

The electric plant is as complete and as thoroughly equipped as can be made.

The vessel is fitted with 1,900 incandescent lamps of 16 candle power, supplied by three multipolar, direct coupled, compound-wound dynamos, driven by horizontal "Ideal" engines, having cylinders 11 inches diameter by 12 inches stroke. The capacity of each dynamo is 400 amperes and 125 volts. Special care has been taken in the wiring of the vessel, and none but extra heavy wires with the very best fire and water-proof insulation have been used.

The "Priscilla" was modeled and generally designed by Mr. George Peirce, Supervisor of the Old Colony Steamboat Company, and has been built under his personal superintendence. In exterior appearance she strongly resembles her mate, the "Puritan," illustrated in our issue of March 21, 1889, with the exception of 20 feet additional length and a slight change in the dome deck-house. The engines and boilers in general design, although 70 per cent. greater in power, are the same as those in the company's last new steamer, the "Plymouth," which was put in commission in the fall of 1890.

The contract for the steamer complete was given to the W. & A. Fletcher Co., Hoboken, N. J., the builders of the machinery and boilers, and they sublet the various contracts for the hull, joiner work, painting and decorating, plumbing, etc.

The handsome surroundings, together with the extreme liberality of W. & A. Fletcher Co. in providing for the comfort of the inner man, made this trial trip of four and one-half hours duration a very enjoyable one to the 700 invited guests on board.

Test of a Pumping Engine.

Editor American Machinist:

I made on Saturday, April 21st, a test of an "E P. Allis & Co. triple compound pumping engine," which they have just furnished to the city of Trenton, N. J., the results of which were highly satisfactory to all parties concerned, and may prove interesting to you.

The engine and pumps were furnished under a guarantee that they would deliver 10,000,000 gals. per day, to a height of 120 feet, with 110 pounds of steam at the engine, and perform a duty of 125,000,000 foot-pounds for every 1,000 pounds of feed water consumed at 30 revolutions per minute.

The boilers were not in the contract, but were built by parties in Trenton, from specifications furnished by Mr. Joseph Ridgeway, M. E., the manager of the Trenton Light and Power Co., and were included in the trials, which were of 8 hours' steady run, from 9 A. M. to 5 P. M., instead of 24 hours, as first agreed upon, from the want of sufficient capacity in the reservoir, to hold 24 hours pumping.

The dimensions of engine were: High-pressure cylinder, 20½ inches diameter; intermediate cylinder, 36 inches diameter; low pressure cylinder, 52 inches diameter; piston rods, 2 each cylinder, at lower end only, 2⅝ inches diameter; pumps, cylinders (3), 25¼ inches diameter. All 36 inches stroke, vertical, single-action; capacity per each revolution, 234.11 gallons, or 1952.5 pounds.

The boilers were three horizontal tubular, 15 feet long, 54 inches diameter, with forty-eight 3½ inch tubes.

Tupper grates, 28 inches below shell, 54 inches by 54 inches, or 20 25 square feet each; 70 75 square feet grate surface in all.

Heating surface, 799.10 square feet each, or 34.17 square feet to 1 square foot of grate. It was necessary to make the test before the connections to return the condensed water to the boilers were made, so that the feed water was taken from the river at 59° F.

The results as noted were as follows: Duration of run, 8 hours; total revolutions of engine, 14,741; revolutions per minute, 30.71; average steam pressure by gauge, 112 27 pounds; average steam pressure, first receiver, 23.8 pounds; average steam pressure, second receiver, 1.75 pounds, average

vacuum, 12 pounds; total head pumped against, 119.62 feet; average temperature feed water, 59°; total coal burned (Lehigh egg), 2,667 pounds; total ashes, 163 pounds; actual evaporation per pound of coal, 9.48 pounds; actual evaporation from 212°, 11.05 pounds; actual evaporation per pound combustible, 11.67 pounds; coal per square foot of grate per hour, 4.71 pounds; total number gallons in 8 hours by plunger displacement, 3,451,015; average indicated horsepower, 234.96; feed water per hour per I. H. P., 13.45 pounds; total weight feedwater pumper, 25,295 pounds; coal per hour per I. H. P., 1.42 pounds; duty per 1,000 pounds feed water, 136,233,000.

The coal was fed hourly, beginning one-half hour before start, and ending at the same time before close. The fires were kept level and even, the water as nearly at the same gauge as possible, and the steam within 5 pounds of same pressure.

Although a longer test might have been more accurate as to the exact consumption of fuel, and economy of boilers, these items were not included in the contract with the Allis Co., and the test of 8 hours was ample to show the capacity of the engine and pumps, while, as stated, the size of the reservoir was insufficient to permit of a longer trial, and the results of the boiler test are believed to be in very close agreement to any which may be obtained by a longer and more elaborate trial.

Charlestown, N. H. SAMUEL WEBBER.

Webb's Academy and Home for Shipbuilders.

The dedication of W. H. Webb's Academy and Home for Shipbuilders took place on the 5th inst. The institution is delightfully situated on Fordham Heights, New York, and is spacious and admirably appointed. The intention is that sixty old shipbuilders and their wives shall in time find a comfortable home here, and that sixty young men shall be instructed in theoretical ship construction. The first occupants came last October. There are now in the institution nine old shipbuilders and their wives, and eight pupils under Professor Jansen, instructor in naval architecture. Thos. Main, M. E., will have charge of the marine engineering department. There will be an examination for candidates for admission to the academy this month.

This munificent gift was tendered by Mr. Webb to the trustees; and on their behalf Mr. Stevenson Taylor, with suitable response, accepted it.

The inception of the plan, and the burden of its accomplishment in all its details, have, like the expense, been borne by W. H. Webb, who has spent so far $470,000 in grounds, buildings and equipments. The endowment will be testamentary.

The trustees are, William Henry Webb, president; Stevenson Taylor, vice-president; Thomas F. Rowland, treasurer; Stephen M. Wright, secretary. Charles S. Smith, Albert G. Bogert, Frederick R Hutton, Merritt Trimble, Henry Steers, Andrew Reed, Charles H. Cramp, Thomas S. Marvel.

Reinard Mannesman.

Mr. Reinard Mannesman, Sr., of Remscheid, Germany, who died recently, was perhaps best known to the younger generation of mechanics in this country through his connection with the Mannesman process of rolling tubes, but there are many other interesting things connected with his life and achievements, he having done very much towards the modern building up of Germany's manufacturing industries, and at the same time basing his efforts upon the very best motives which influence men in making progress.

Mr. Mannesman's father owned an old-fashioned steel works which when his son took its management was improved and made famous, the subject of this sketch finally making his files as well and as favorably known upon the continent of Europe as the best English files.

Socially and politically, also, he was prominent, and the very high regard in which he was held by his workmen is shown by the fact that during the great strike of 1873 he was selected by them as their representative, although from the narrow point of view, his interests as a manufacturer were against those whom he was thus chosen to represent. Mr. Mannesman was in his 80th year when he died, and leaves six sons who are technically trained in the same line as that pursued by him.

The difference in spirit manifested by engineers and scientists, on the one hand, and by politicians on the other, was shown in connection with Mr. Mannesman's exhibit of files at Paris in 1867. The files were awarded gold medals, and it was proposed to give him the *croix d'honneur*, but Napoleon III. declined to grant this distinction, writing upon the margin of the jury's report, "To a Prussian, never!"

MANUFACTURES

An electric-light plant will be located at Cassopolis, Mich.

Joseph H. Abels will locate at Rosedale, Miss., a saw mill plant.

Rice & Holden will erect a new manufactory at Leominster, Mass.

A new electric power plant will probably be erected at Essex, Conn.

West Union, Ia., is talking of adopting an electric-lighting system.

A municipal electric-light plant will be established at Columbia, S. C.

The Page Belting Company will at once build its burned tannery at Concord, N. H.

The Brush Electric Light and Power Company will erect a new plant at Savannah, Ga.

Enoch Waite will probably rebuild at once his felting-mill, recently burned, at Franklin, Mass.

J. B. P. Smith, of Baltimore, is interested in an electric company to build a plant at Washington.

The Stanley works at New Britain, Conn., which have been working 8 hours a day, began a 9-hour schedule Monday.

It is intended to locate a new electrical power house at Essex, Conn., to supply power for a railway to Ivoryton.

The Seth Thomas Clock Co., in Thomaston, Conn., has posted notices that it will run 10 hours a day, four days per week.

The stockholders of the Shelbyville (Ky.) Water and Electric Light Co., have organized with Louis Channing as president.

The Brush Electric Light and Power Company, Savannah, Ga., intends to build a new plant. About $50,000 will be expended.

It is stated that the rolling mill of the Ohio Steel Co., now building at Youngstown, O., will be arranged to make steel rails.

The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a gas house extension for the Brookline Gas Co., at Allston, Mass.

Frank G. Hoopes and Otho L. Parker, Baltimore, Md., have incorporated the Co perage and Machine Co. The capital stock is $10,000.

Business is said to be lively at the Bridgewater (Conn.) Iron Works at present. Many car loads of scrap iron have been received to be melted.

The Westchester Auxiliary Fire Alarm Co., of Yonkers, N. Y., has been incorporated. Capital, $15,000, and directors J. Westervelt and F. Reckenzaun.

It is said that fruitless efforts have been made to induce the Racine Malleable Iron Co. to remove to other localities, but they have decided to remain at Racine, Wis.

The Lowell (Mass.) Machine Shop has decided to run on full time, 58 hours per week. The establishment employs about 700 men in the manufacture of cotton machinery.

At Springfield, Mass., F. L. Cook and E. A. Belding have organized a co-partnership for the manufacture of an eel-skin armor for pneumatic tires, and the business will be opened about the first of next week.

The American Paper Pulley Co., of Indianapolis, Ind., shipped 18 large paper wheels to Japan for

KEEP A LOG-BOOK

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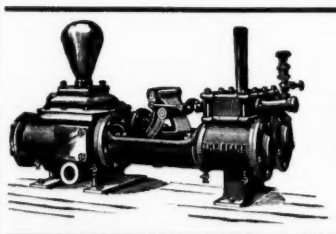

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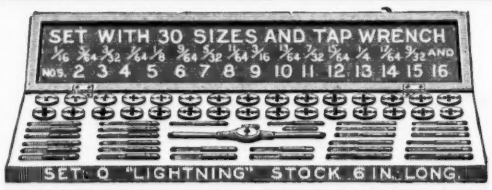

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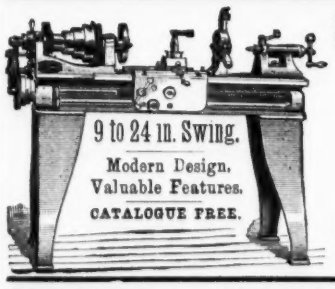

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Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
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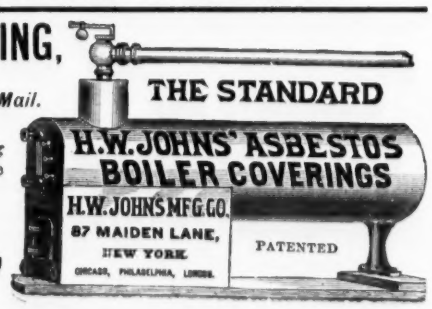

use in an electric light and street-car plant. The purchase was made through the Thompson-Houston Electric Motor Power Company.

Several business men of Spencer, Mass., among whom is G. Prouty, of the firm of I. Prouty & Co., have decided to organize a stock company, to succeed the Prouty firm. The capital stock of the new firm will amount to $400,000.

The building now under erection by the Canton (O.) Rolling Mill Co. is expected to be finished about July 1st next. The new concern will engage in the manufacture of iron and steel sheets, and expects to turn out from 25 to 35 tons per day.

The Addyston Pipe and Steel Co., of Addyston, O., near Cincinnati, are erecting new machine shops for their already extensive works. The Lodge & Davis Machine Tool Co., of Cincinnati, O., have secured an order for four large lathes to be used in the above shops.

The Berlin Iron Bridge Company, at East Berlin, has bought seven acres of land adjoining its present plant for an extension of its works. Included in the new buildings to be erected is a large building in which massive machinery will be built to straighten iron plates—work which is now being done by hand. The business of the company is improving.

The Chicago office and warerooms of the E. W. Bliss Co. have been removed from 14 N. Canal street into more commodious quarters at 100-104 West Washington street, near Desplaines street. The office will still remain in charge of Mr. C. W. Ellsworth, late superintendent of the Chicago Stamping Co., and a complete line of presses, drop hammers, shears, and sheet-metal machinery will be carried as formerly.

We have received from the Connersville Blower Co., Connersville, Ind., a catalogue illustrating and describing their various forms of Cycloidal Positive Blast Blowers, and also the machine for planing the cycloidal surfaces of the impellers, which has been illustrated in these columns. The catalogue is an interesting one to mechanics, especially those who have to do with supplying air under pressure, and is sent upon application.

We have received from the Tabor Manufacturing Co., 111 Liberty street, New York, a catalogue illustrating and describing their improved Molding Machines. Besides full illustrated descriptions of the various styles of machines built by the company, there is a paper by Mr. Harris Tabor, on the "Economies of Molding Machines," which was read before the Foundrymen's Association, of Philadelphia, and which will be found of interest to mechanics. Catalogue is sent to those interested upon application.

Knight & Jillson, of Indianapolis, Ind., report business assuming old-time proportions among gas and water companies and manufacturers throughout the State. Last week they shipped seven carloads of large-sized pipe to the gas region in the neighborhood of Jonesboro, Gas City and Marion, and three carloads of pipe to Elwood. This week they closed contracts for 360 tons cast-iron water pipe and other appliances for water-works construction. By reason of the facility with which good securities can be placed a great many towns are putting in water-works.

In a new invention the mechanism is described as a hollow cylinder 10⅛ feet in circumference, to which the grain of a piece of oak of the width of the cylinder has been transferred, this grain being covering with a soft cement which sinks into the depressions, and in these about 200,000 bits of metal-like type are set, above this being placed a small, smooth steel cylinder adjustable to different heights; between the two cylinders, both revolving, a piece of birch, poplar, bass, spruce or maple may be passed which comes out with the grain of the oak transferred to it.

We have received from the Meriden Machine Tool Co., Meriden, Conn., a neatly framed copy of some engrossed resolutions purporting to have been adopted by the executive department of the Brass, Brittania, Casket Trimming and Silver Plate Manufacturing Association of America, whose address is not given. Over the signatures of Messrs. D. O. Goodwork and Practice E. Conomy, president and secretary, respectively, it is stated that the forming lathes built by the above-named company are indispensable, and must be used by every member of the Association.

The new terminal facilities for the New York, New Haven & Hartford R. R., at Providence, R. I., will necessitate two large bridges, which will be furnished by The Berlin Iron Bridge Co., of East Berlin, Conn. These bridges will carry 16 tracks over Gaspee street, Promenade street, and Woonasquatucket River. The bridges will be plate girders resting on abutments at the street line, and columns at the curb line. There will be no floor beams or stringers used, but in place of these will be a metal floor supporting ballast, in which the ties and rails will be bedded. The work will require about 4,500 tons of open hearth steel material. The Berlin Company are to be allowed six months in which to complete the work.

Machinists' Supplies and Iron.

NEW YORK, May 12, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.25; No. 2, $11.50 to $12.25; Gray Forge, $10.75 to $11.00. Southern brands are quoted at $11 50 to $12.25 for No. 1 Foundry; $10.50 to $11.00 for No. 2, and $10.00 to $10.25 for No. 3.

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No.	INCH.	PRICE.	No.	INCH.	PRICE
1	5/8	$ .35	8	2	$1.10
2	7/8	.35	Small set of 8—5.50		
3	3/4	.50	9	2 1/8	1.40
4	1	.60	10	3	1.50
5	1 1/4	.75	11	3 1/8	1.70
6	1 1/2	.85	12	4	1.90
7	1 3/4	1.00	Full set of 12—12.00		

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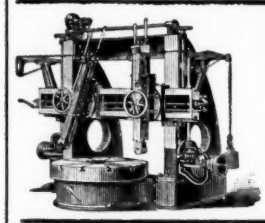

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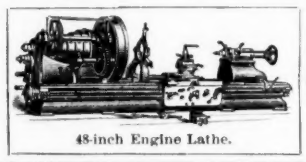
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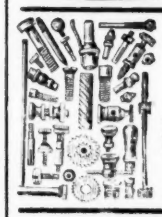

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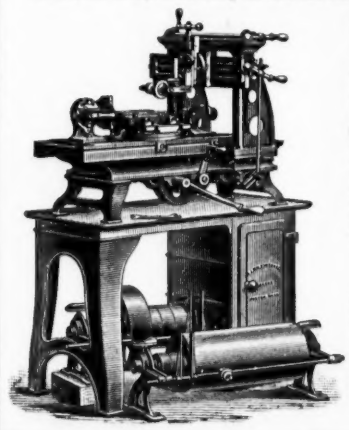

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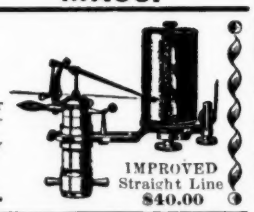

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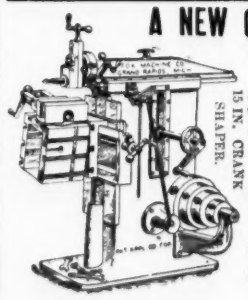

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A mech. engineer, thorough machinist, good designer and draftsman, desires situation with growing concern; will invest $500. Advance, Am. Mach.

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Wanted—Immediately, for a few weeks only, just now, a thoroughly good mechanical draftsman, not over 30 years of age; must be a graduate of a Polytechnic school. To the right party this may lead to a good acquaintance, and eventually permanent work with me. Address A. H. Emery, Stamford, Conn.

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For Sale—Second-hand drill presses,engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

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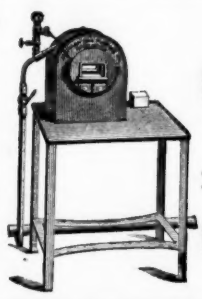

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Modern Style, in Good Order, Being the Equipment of a
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800 " " " "
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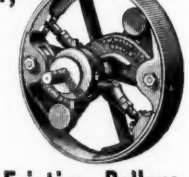

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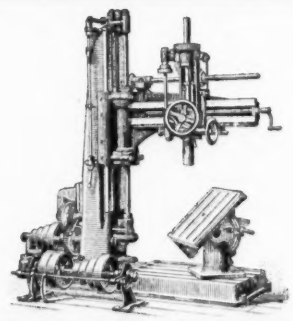

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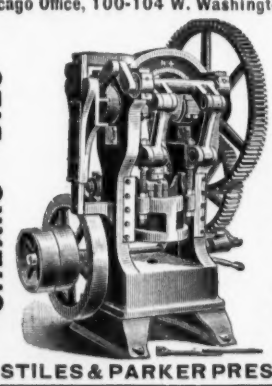

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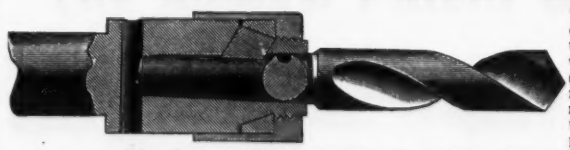

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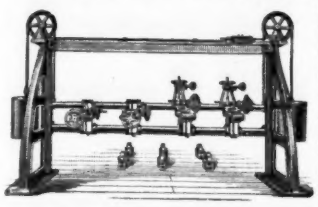

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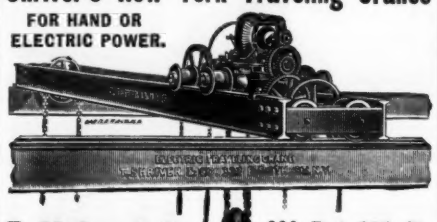

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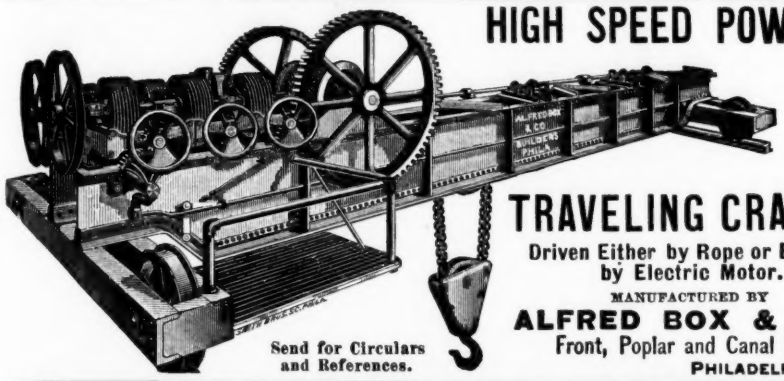

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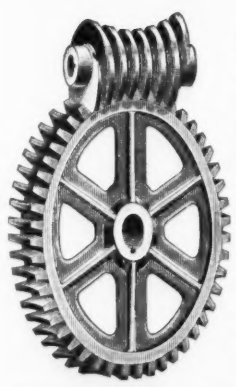

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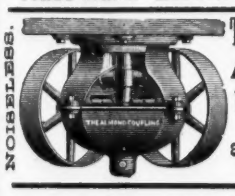

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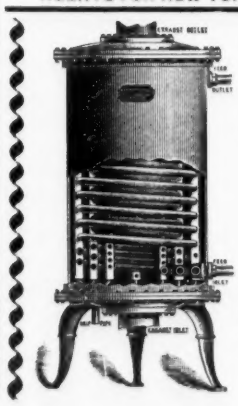

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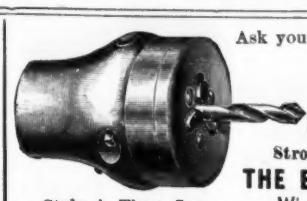

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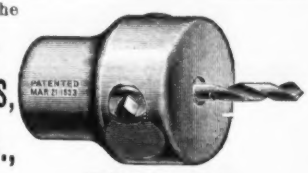

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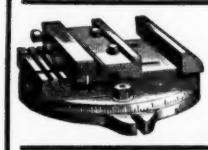

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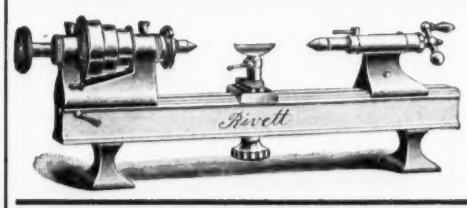

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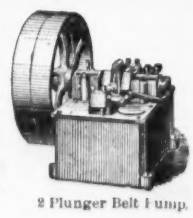
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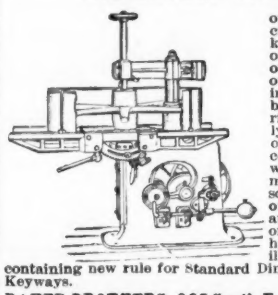

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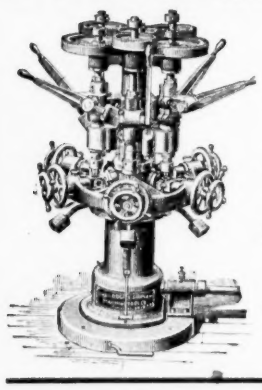

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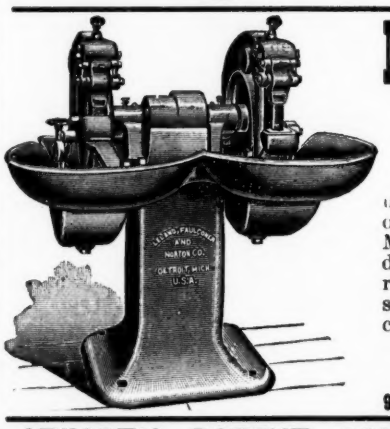

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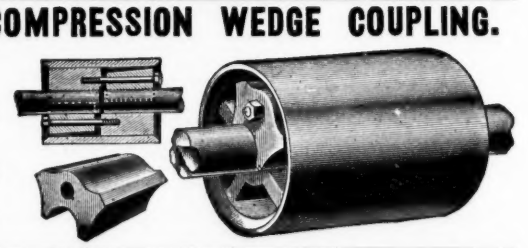

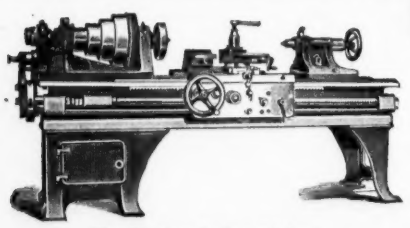

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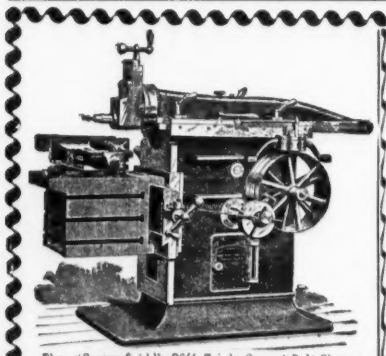

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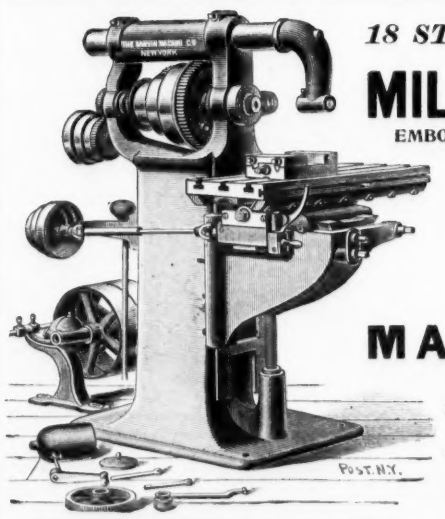

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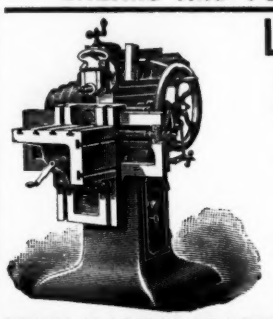

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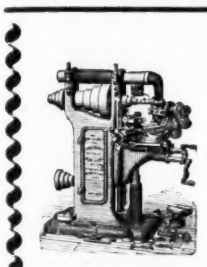

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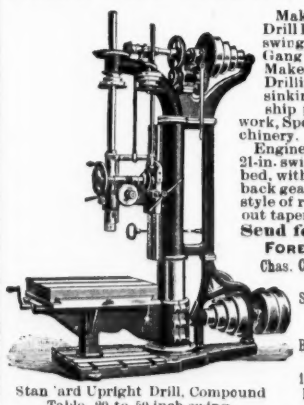

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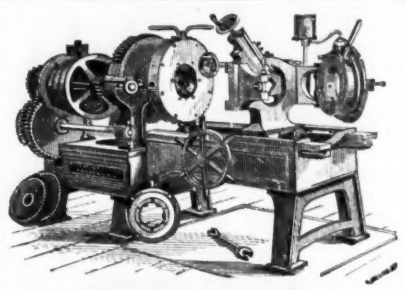

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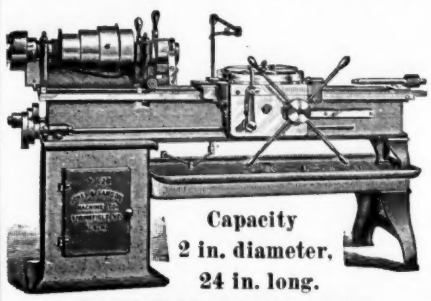

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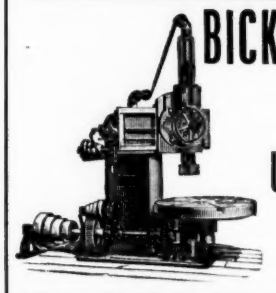

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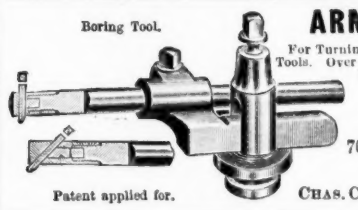

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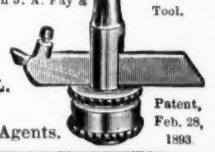

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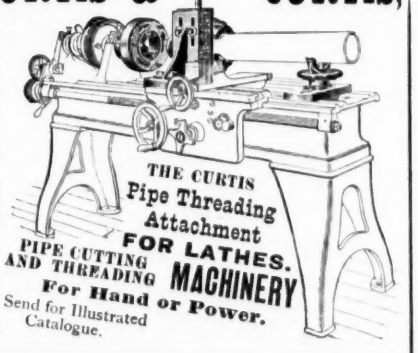

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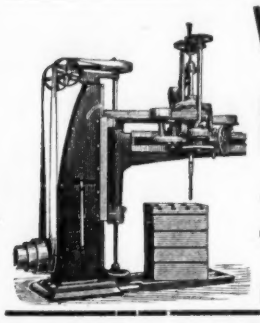

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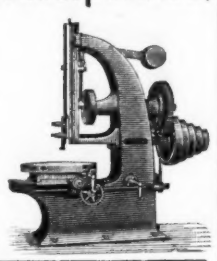

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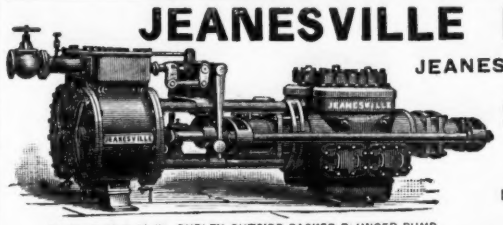

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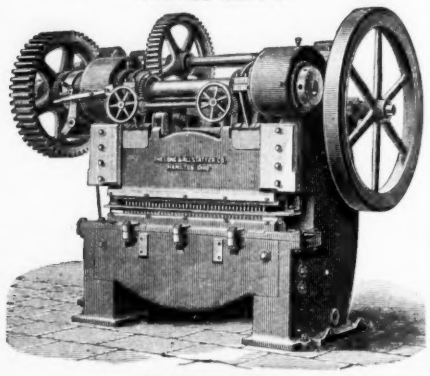

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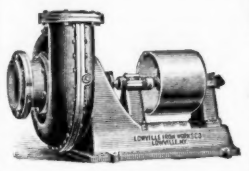

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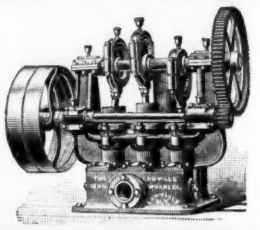

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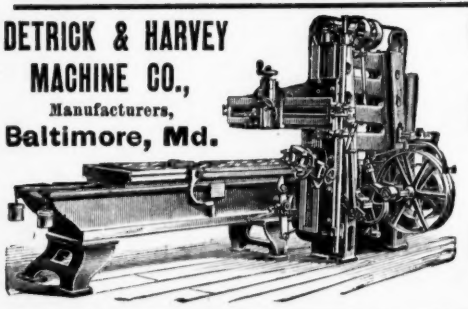

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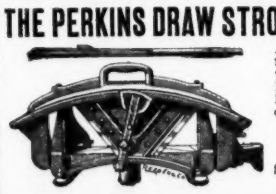

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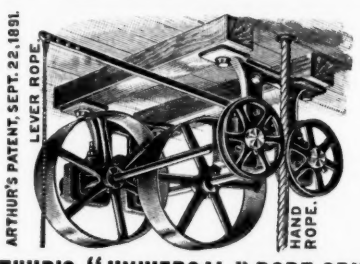

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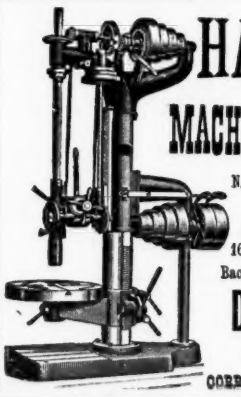

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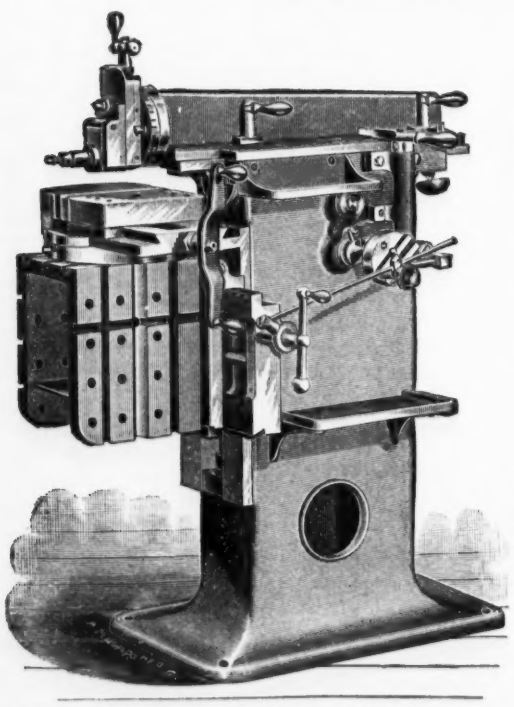

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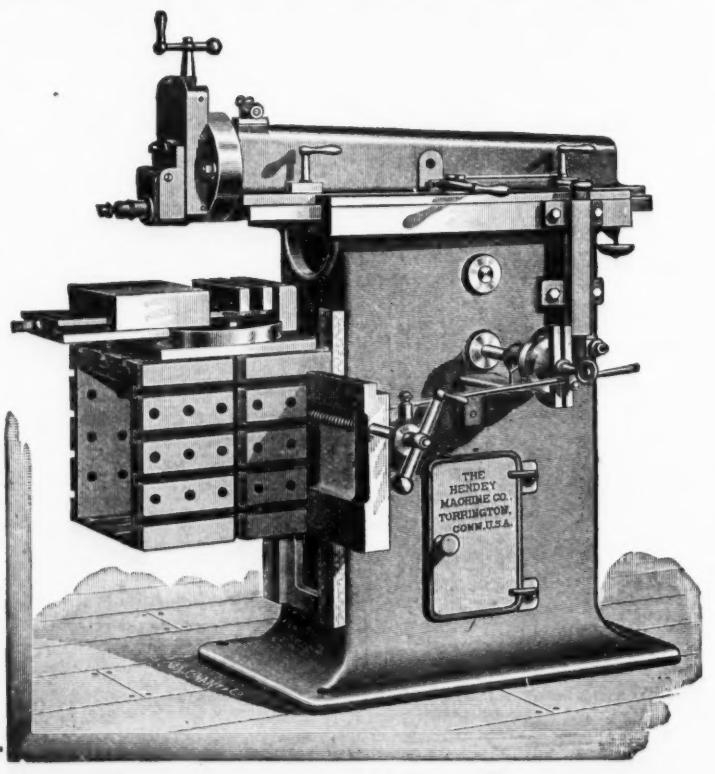

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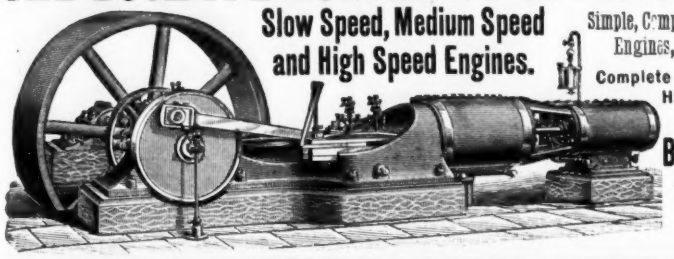

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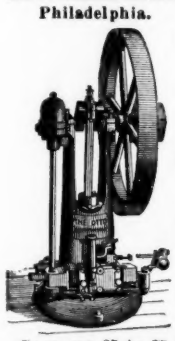

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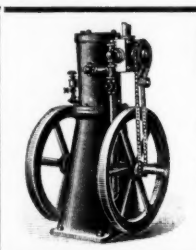

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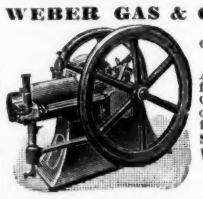

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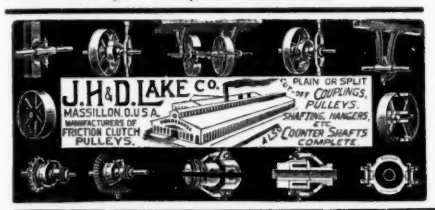
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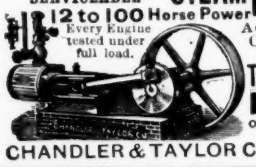

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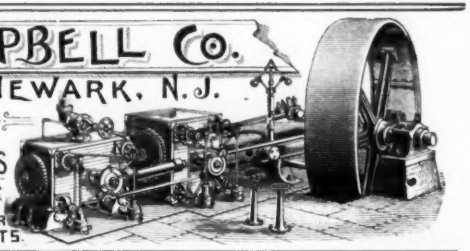

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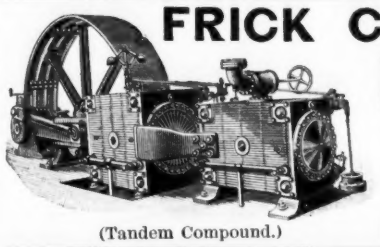

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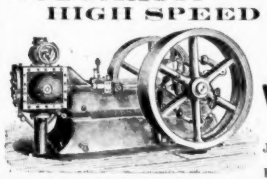

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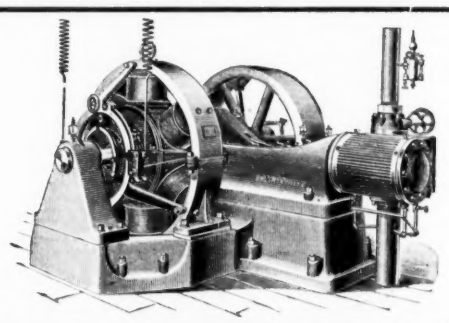

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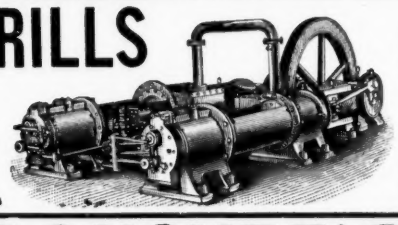

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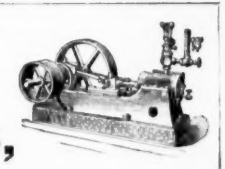

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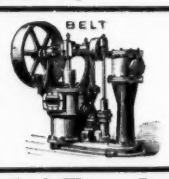

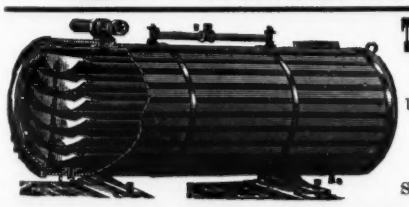

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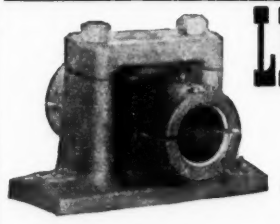

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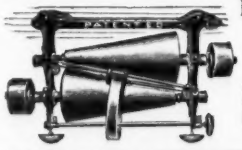

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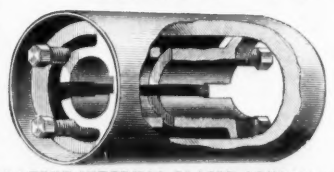

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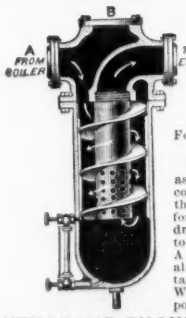

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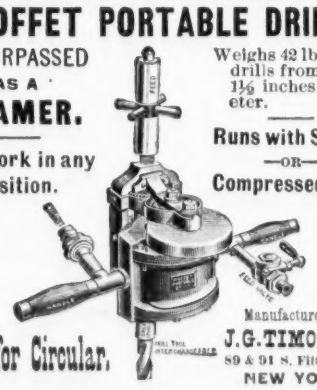

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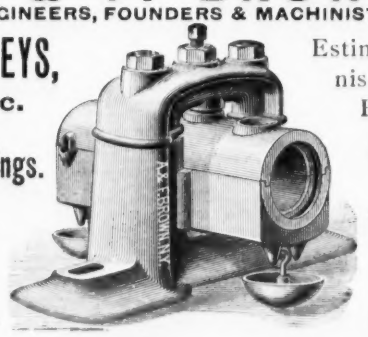

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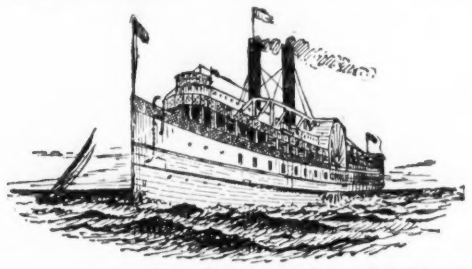

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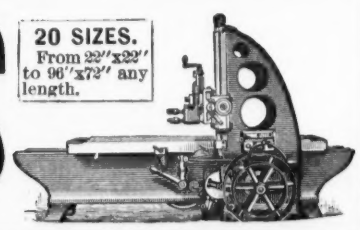

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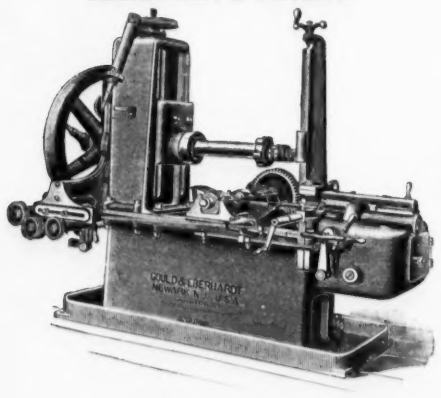

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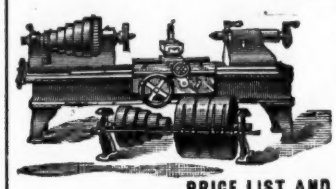

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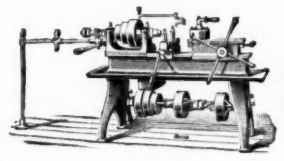

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